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THE VILLAGE SCHOOL: A POWERFUL POTENTIAL FACTOR IN RURAL IMPROVEMENT¹

As an agency for rural improvement, the village school has a great potentiality. It occupies a very advantageous position for the extension of all governmental activities in the rural districts. Geographically, it stands in the midst of potential wealth, the lands that surround it, farms, forests and pastures, and, in addition, along the coasts, the fisheries.

The village school, through the village school children and otherwise, is in contact with all the people in its rural district. This contact is constant and friendly, and it can be used to advantage. No institution created for the improvement of rural conditions can attain the highest degree of usefulness and efficiency unless it can maintain constant and friendly contact with the people.

The rural people look toward the village school for leadership and guidance. For them, the school is a source of information, instruction, and inspiration. Tradition ties the village people to the village school.

All governmental activities that have anything to do with the education, health, public welfare, agriculture, etc., for the rural people can be most economically consolidated and extended through the village school. There is no agency in the rural community that is more stable and is held in higher respect than the village school. Of all the Government institutions, only the Bureau of Education has a wonderfully efficient system of agencies that keeps it in contact with the families living in the remotest corners of the Archipelago. By the nature of their organizations, the other Government institutions can not be furnished with like systems. Economy forbids. It is not necessary that they be furnished with such a system. Means must be sought so that the several institutions concerned may find a way to use the village school for the extension of their activities. Co-operation is an all powerful means under the present system of Governmental organizations. It opens a way for the solution of vexed administrative questions and overlapping activities. Bureaus must co-operate for the extension of their activities to the rural districts for the sake of efficiency. The village school can be made a central agency for these activities.

The improvement of the village school as an educational and social center needs the most urgent consideration. Most of the pupils that fail to complete the primary grades are children in the rural districts, the future producers of agricultural products of the country. There are several reasons for their few years in school. Rural people are too poor to let their children continue school-

¹ General contribution from College of Agriculture No. 160.

ing in towns where the higher grades are taught. They need their children to help them in their farm work. Also many rural children are so poorly prepared in their school work that they can not catch up with the town children. Generally they quit school before completing the primary grades. Most of the graduates in the elementary schools are city children. Among the high school graduates there are very few who come from the rural districts. This is one reason why our high school graduates do not go to the farm. They do not come from the farm.

The farmers do not come from children raised and trained in cities. With the exception of a few who were trained in the farm and agricultural schools, the farming population comes from the children in the rural districts. City families rear city people and rural families, rural people. Therefore, if we want to raise the proportion and standard of our rural population we must keep in mind that the village schools in the rural districts are the places where the people get their initial training.

The village school can be used as an educational center for the older people, as a social center of the rural community, as a health center and as a recreational center. The rural people know very little about what is going on in their towns and provinces, much less about what is going on in the country and in the world. A provincial or regional newspaper and a Philippines weekly, at least, should be in the village school library. A weekly or bi-weekly gathering of the older people to learn the current news will help raise the educational level of the rural community. Rural people are oftentimes misinformed about agricultural, economic, and political conditions. Correct news and information can be transmitted to the older people in the rural districts through the village school children. Civico-educational lectures adapted to the needs of the rural communities are of great value.

Social intercourse among the rural people should be promoted. Social intercourse begets friendship and understanding, and understanding begets co-operation. There should be a room in the village school for social purposes.

The village school can be used as a health center. Health work in the villages should be carried on in connection with the village school. A small cabinet containing first aid remedies in the school building would be very handy for cases not needing expert medical treatment.

We are spending much of the Government income for the aggrandizement of city institutions. We are making city conditions very inviting to the rural people. The flow of the rural population into the cities should be curtailed. Improvement of rural conditions and spirit will tend to dam the flow. The improvement of the village school in physical plant, equipment, and personnel should take precedence over all projects of the Government in the rural districts.

The taxes that come from the rural districts should be spent for the improvement of rural conditions. A law so providing would be a blessing to the country. The Insular aid to the academic high schools—most of it—should be shifted to the schools in the rural districts. Part of the municipal income for general and school purposes should also be set aside for the improvement of rural conditions.

The expenditure of more money of the Government in the rural districts will be conducive to symmetrical and well balanced development of the country, educationally, socially, and economically. We need an intelligent rural class.

We need it to neutralize city radicalism. We need it to stabilize conditions, political and economic. How many times the countries of Europe have been saved from political chaos and economic crisis by the rural class. We must develop a rural class to produce our food and to produce the raw materials for industry and manufacture. The development can be most advantageously made by means of the village school or consolidated school or any kind of school in the rural districts. We can not develop a rural class in the city. The rural atmosphere is not there. The rural problem must be attacked first and foremost in the rural districts.

TORIBIO VIBAR
Of Department of Agronomy

THIRD ADDITION TO PHILIPPINE AND MALAYAN TECHNICAL BIBLIOGRAPHY¹

R
CHARLES FULLER BAKER

Dean, College of Agriculture

Based wholly or partly on materials furnished by C. F. Baker, the rapid growth of this great series of contributions still continues unabated. Added to the 277 titles of the three preceding lists, the present list brings the total of titles up to 362. A still wider distribution of materials has been obtained, so that now 110 of the best specialists of the world in their various lines, are actively engaged. So rich have been some of the materials supplied that continuous work in some groups for the next ten years will be assured, even were C. F. Baker to die tomorrow. As usual, all operations connected with this work have been extra-official and at personal expense.

Already we are beginning to realize one of the principal objects of this undertaking—comprehensive synoptic treatments of the principal groups for the Philippines, that will lay broadly the foundations for the future entomology of this great and varied archipelago. In other words, the Philippines is coming into possession and practical use of an extensive entomological literature. The student need no longer flounder with complete uncertainty, through a morass of the largely unknown. Important sections of the field are being rapidly elucidated. In this connection, the obligation of Philippine students to the many devoted specialists engaged, is very great.

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¹ Experiment Station contribution No. 343.

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STUDIES ON THE TOXICITY OF COPRA MEAL: II¹

VICTOR SULIT

WITH NINE CHARTS

The first part of these studies, which appeared in this journal last month, dealt with guinea pigs, animals that are to a large extent herbivorous. It was found with these animals that when copra meal formed from 75 to 85 per cent of an otherwise complete ration, it gave rise to various disorders which ended fatally. As it seemed of sufficient interest and importance to observe the reactions of another type of animal to this property of copra meal, the investigation was continued with white rats, an omnivorous type of animal.

MATERIALS AND METHODS

Animals. The albino rats used were, on the average, about three months old and weighed from 80 to 170 grams, about. The animals were kept individually, but during the period of experiments those in each lot were occasionally bred.

Copra meal. Copra meal I, an expeller product, was the copra meal used in all the tests here reported.

Preparation of feeds

Butterfat. Butterfat was obtained by warming butter of high quality over water bath at temperatures of from 40° to 50° C. The top layer of fat was separated and used as butterfat.

Copra meal, casein, corn, and rice. These were separately pulverized and passed through a one-millimeter sieve.

Starch. Corn starch with the trade name "Liberty" was purchased from the local market and used without further treatment.

Salt mixture. The synthetic salt mixture number 207 of Osborne and Mendel as given in Hawk's *Practical Physiological Chemistry* (1921) was used throughout.

Fibers. Filter paper of high quality was soaked in water and washed several times. It was then passed through a meat grinder two or three times. The mass was then pressed and dried, and once more passed through a meat grinder before it was used.

Rice bran extract. Rice bran as purchased from the market was extracted with water. The mass was filtered through cloth and the filtrate evaporated over water bath to a syrupy consistency and then to dryness. The hardened black mass was dissolved in water before being incorporated into the ration.

Water. Boiled water was used throughout this series of experiments.

¹ Part of the thesis presented, 1923, for the degree of Master of Science from the University of the Philippines, No. 219; Experiment Station contribution No. 344.

Preparation of the rations

The rations that were used for this series of experiments had the same composition as those used for the guinea pigs in part I of this work.

Control ration. The control ration used had the following composition:

Corn.....	37.0 grams
Rice (polished).....	30.0 "
Casein.....	15.0 "
Salt mixture.....	4.0 "
Butterfat.....	14.0 "

This control ration, used by Macy and Mendel (1920) was slightly modified. To this ration was added some grated fibers of filter paper to increase bulk and supply fibers and thus prevent constipation.

Experimental rations. Only one kind of copra meal was used in all these experiments. The following rations which contain varying proportions of copra meal have about the same percentage of protein and other necessary ingredients.

Ration 1

Copra meal.....	75 grams
Casein.....	7 "
Salt mixture.....	4 "
Butterfat.....	14 "

Ration 2

Copra meal.....	80 grams
Casein.....	6 "
Salt mixture.....	4 "
Butterfat.....	10 "

Ration 3

Copra meal.....	85 grams
Casein.....	5 "
Salt mixture.....	4 "
Butterfat.....	6 "

Ration 4

Copra meal.....	37.5 grams
Casein.....	13.5 "
Salt mixture.....	4.0 "
Starch.....	31.0 "
Butterfat.....	14.0 "

Differences in the physiological reactions of the young rats may easily be due to the amounts of protein. This result was, however, obviated by the fact that each of the experimental rations contained about twenty per cent of the protein. The control ration, on the other hand, contained about only fifteen per cent.

Because of the presence of vitamin A in copra meal (Sherman and Smith, 1922) the ration with large proportions of copra meal received correspondingly less butterfat. Lessening this ingredient reduced an unnecessarily high amount of fat in rations with large amount of copra meal. Thus, a high amount of fat in any of the rations which might be a source of trouble was avoided.

Although copra meal contains vitamin B according to a number of investigators (Jansen, 1918, and Haliburton and Drummond, 1918) rice bran extract

was used with the ration. This was to counteract any trouble that might develop owing to the great susceptibility of albino rats to the absence of this accessory food factor (Donaldson, 1924.)

Care of animals

The animals were kept in regular cylindrical experimental cages, made of heavy wire netting soldered together, which measure about 30 centimeters high and 20 centimeters in diameter. The bottom piece is a shallow galvanized iron pan. When in use, a layer of dry excelsior was placed over the bottom of the pan. This material was covered with a piece of closely fitting wire gauze to prevent the animal from eating or gnawing the excelsior. The cages were cleaned and dried twice a week, and the excelsior changed as often as necessary. The animals were kept in a well ventilated place, receiving the early morning sun for one or two hours.

Feed container. All the rations were kept in glass jars, which were cleaned once a week. Regular feeding and drinking cups for animals, made of galvanized iron, were used; these were cleaned once a day and scalded twice a week.

Feedings. Fresh feed was given to the animals as needed. Food intake was ascertained whenever possible.

Rice bran extract. In all cases the rice bran extract was mixed with the feed.

Weighing the animals. The animals were weighed once a week in a "Cenco" balance.

EXPERIMENTS AND RESULTS

Control feedings

As check for the animals in the different lots, three animals were started on the control ration at the same time that the other lots were started. All the three animals exhibited normal growth throughout the course of the experiments, a period of about seven months.

Rat No. 183 ♀ was bred once with rat No. 197 ♂ and successfully raised a litter of young during the course of the experiment.

Rat No. 135 ♀, which was occasionally kept with No. 197 ♂, produced three litters of young during the course of the experiment. Two of the litters were raised successfully. The young in the other litter were all killed accidentally. In every case all the young were born alive.

The three animals maintained a fairly rapid rate of growth. All the animals, including the young, manifested normal vigor and were all healthy throughout the course of the experiment (see table 1).

TABLE 1

Showing duration of experiment, total food intake, and growth of the animals in the different lots

ANIMAL	RATION	DURA- TION	TOTAL FOOD INTAKE	INITIAL WEIGHT	WEIGHT AFTER	GAIN IN WEIGHT	REMARKS
		days	grams	grams	grams		
Rat No. 191♀	1	191	2086	117	130	13	Not normal
Rat No. 184♂	1	191	2089	126	202	76	Not normal
Rat No. 134♀	1	191	2066	138	143	5	Not normal
Rat No. 143♂	2	191	2062	149	184	35	Not normal
Rat No. 132♂	2	191	2061	165	172	7	Not normal
Rat No. 133♂	2	191	2046	163	197	34	Not normal
Rat No. 144♀	2	191	1962	123	140	17	Not normal
Rat No. 185♀	2	191	2153	102	128	26	Not normal
Rat No. 186♀	2	191	2268	92	120	28	Not normal
Rat No. 141♂	3	191	2203	145	166	21	Not normal
Rat No. 187♂	3	191	2133	122	153	31	Not normal
Rat No. 142♀	3	191	2240	129	138	9	Not normal
Rat No. 190♂	3	191	2228	130	162	32	Not normal
Rat No. 188♀	3	53	453	80	88	8	Died Sept. 30, 1922
Rat No. 140♂	4	191	2259	178	308	130	Normal
Rat No. 196♀	4	191	2146	132	205	73	Normal
Rat No. 189♂	4	191	2183	113	278	165	Normal
Rat No. 157♀	4	191	1942	129	217	88	Normal
Rat No. 197♂	5	191	2071	167	293	126	Normal
Rat No. 135♀	5	191	2057	163	239	76	Normal
Rat No. 183♀	5	191	2302	78	200	122	Normal

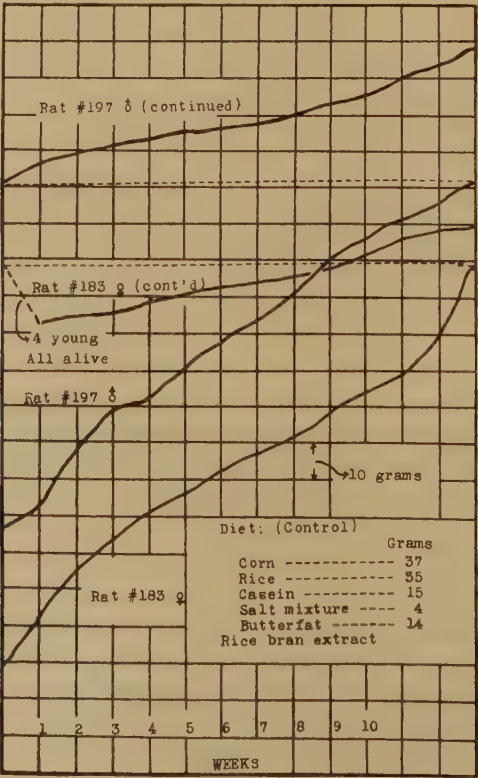


Chart 1.—Typical weight curves of male and female albino rats for several months, showing their behavior on a diet containing no copra meal.

Albino rats on a diet of copra meal alone

Copra meal has been shown by a number of investigators to contain all the essential elements of a good feed in proper proportions, besides having a high coefficient of digestibility. Therefore, it is reasonable to expect normal development of albino rats on copra meal alone.

Four normally growing individuals, rats No. MI ♂, No. FI ♀, No. MII ♂, and No. FII ♀ were given copra meal plus fresh water *ad libitum*. These four rats were raised on the control ration. All decreased in weight on copra meal and water. After two weeks on copra meal diet they began to show emaciation, inactivity, constipation, and sometimes diarrhea. Emaciation continued until the animals were very weak.

Albino rats on rations with high proportion of copra meal

Johns, Finks, and Paul (1919) used copra meal made in the laboratory to the extent of about 75 per cent in a ration and found it to be quite satisfactory. In these tests, commercial copra meal was used.

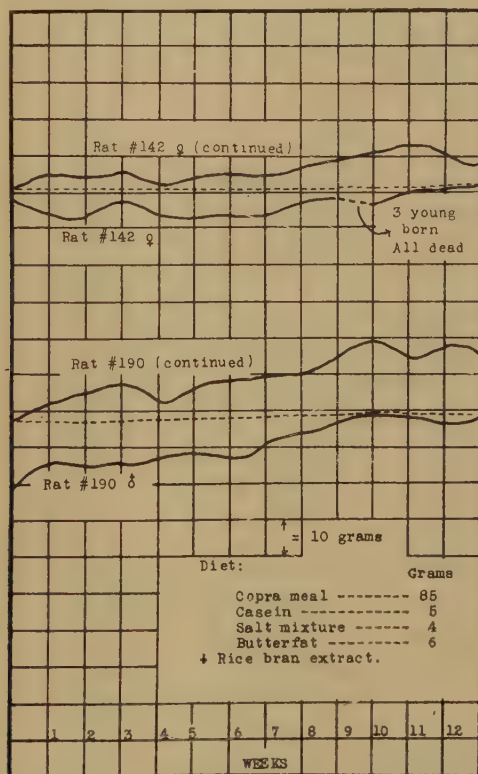


Chart 2.—Typical weight curves of male and female albino rats, showing their behavior for several months on a complete diet which contained 85 per cent of copra meal.

Copra meal, 85 per cent. To ascertain the possible deleterious effect of copra meal on rats, ration 3 supplemented with rice bran extract was fed to five rats. The experiments were begun at the same time as the control lot and were kept

in the same place. All the animals exhibited fluctuating growth and throughout the long course of the test showed poor and retarded growth.

For some reason unknown, rat No. 188 ♀ died after about two months' feeding. In the first part of the experiment, this animal ate normally, then it began to exhibit inactivity and emaciation. It gave birth to four young, three of which were born dead. Soon after, both the mother and the one young died.

All five animals manifested unhealthy body conditions and showed occasional inactivity and weakness. At times the animals had periodical diarrhea, more or less profuse. After a period of about seven months all were in an apparently run down condition, especially the females. Increased use of rice bran extract effected no cure.

Rat No. 142 ♀ produced a litter of three young, all born dead.

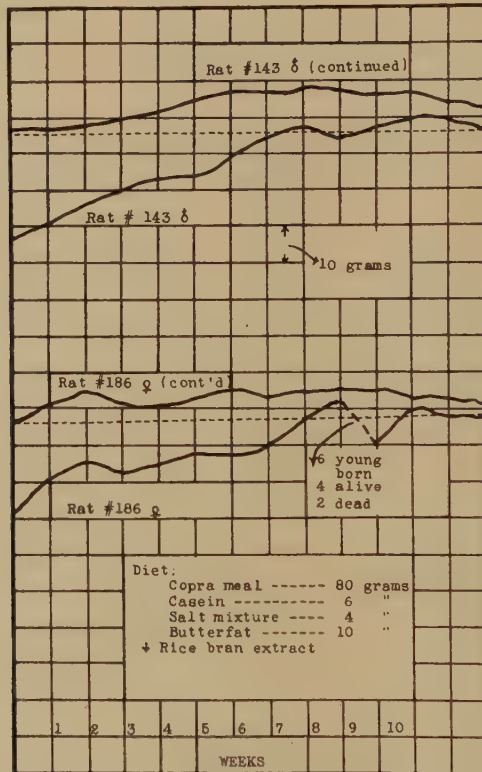


Chart 3.—Typical weight curves of male and female albino rats, showing their behavior for several months on a complete diet which contained 80 per cent of copra meal.

The unhealthy condition and stunted growth may not be attributed to food intake, for a comparison of the food intake of these animals with those in the control lot shows that the animals in the two lots had, on the average, practically the same amount of food intake (see table 1).

Copra meal, 80 per cent. Ration 2, supplemented with rice bran extract, was used with six white rats. As with the animals fed with ration 3, these rats did not grow normally and were, in general, physically weak. All had occasional

diarrhea. The females seemed to suffer more than the males. As in the former cases, increased use of rice bran extract resulted in no improvement.

Rat No. 185 ♀ produced two litters of young. There were seven in the first litter, three were born dead and the rest died after a few days. The second litter consisted of four young, all prematurely born. Rat No. 144 ♀ produced one litter of three young, two of which were born dead and the other died within a few days. Rat No. 186 ♀ produced six young, two of which were born dead, and one died during the course of the experiment. The other three were still living when the experiment was stopped, but all were in a very emaciated condition. A comparison of the food intake of these animals with that of the control lot showed that on the average it is about the same (see table 1).

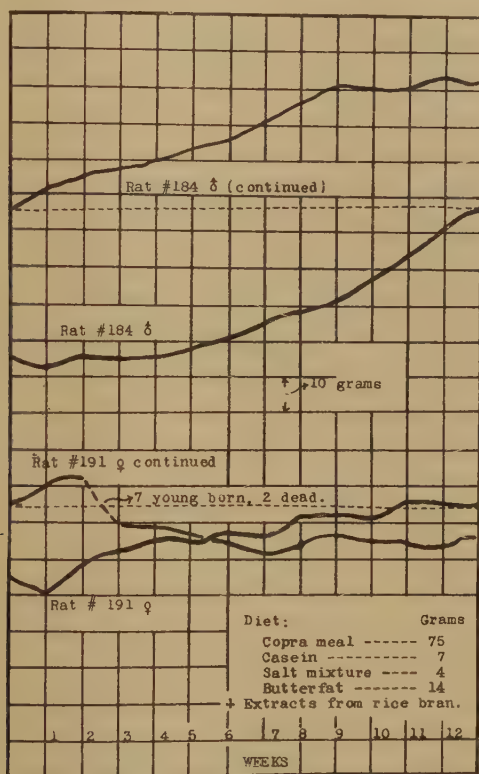


Chart 4.—Typical weight curves of male and female albino rats, showing their behavior for several months on a complete diet which contained 75 per cent of copra meal.

Copra meal, 75 per cent. To observe the reactions and behavior of animals when copra meal is lowered to 75 per cent, three of the rats were given ration 1, supplemented with rice bran extract. The test was started at the same time as the others.

The growth of these animals as compared with the growth of those fed rations 2 and 3 was, on the whole, very much better. Rat No. 184 ♂ exhibited a fairly satisfactory growth, although still below normal. Rat No. 191 ♀ and rat No. 134 ♀ showed very poor growth toward the latter part of the experiment.

Rat No. 134 ♀ produced seven young, all born alive, but three died in the course of the experiment. Rat No. 191 ♀ produced seven young, two of which were born dead; of the remaining five, one died in the course of the experiment.

Compared with animals of the same age, in the control lot, these three were not healthy and apparently were not normal. Compared with those on rations 2 and 3, they were the better although they were also quite emaciated. During the course of the experiment they showed weakness and occasional inactivity. The food intake of these three animals was, on the average, about the same as that of the control lot (see table 1).

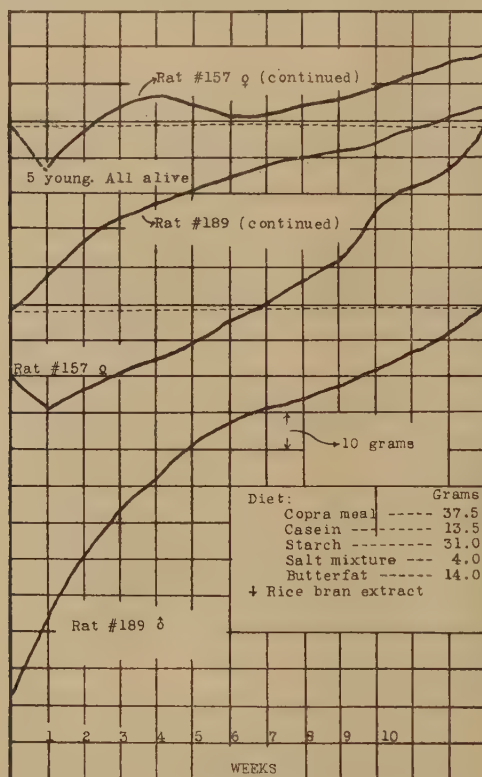


Chart 5.—Typical weight curves of male and female albino rats, showing their behavior for several months on a complete diet which contained only 37.5 per cent of copra meal.

Albino rats on low proportion of copra meal

Four animals were given ration 4 supplemented with rice bran extract, as in the other lots. Compared with the animals in the lots with high percentage of copra meal, these animals exhibited very much better growth. They all appeared normal in body condition. No diarrhea or other abnormalities were noticed. The two females produced and reared young successfully. The food intake on the average was about the same as with the control ration. The animals showed normal growth on this diet during a period of seven months.

Rat No. 196 ♀ gave birth to a litter of young, all born alive. They grew normally for about two weeks, when they began to grow emaciated; some of them

died and others were killed by the mother (see table 2). Rat No. 157 ♀ in the same lot gave birth to five young, one of which died when a week old. The rice bran extract was then increased in the ration. The young rats grew normally and were reared by the mother successfully. This result was not brought about by increased use of rice bran extract with animals fed with rations containing a high percentage of copra meal.

From the observations made it appears that when copra meal formed about 37 per cent of an otherwise complete ration, there was no deleterious effect. Copra meal in such proportion seems to be highly beneficial, although there seemed to be an apparent lack of vitamin B.

These results indicate that with about 75 per cent, or more, of copra meal, a ration contained an appreciable amount of water soluble B; and, therefore, the deleterious effect produced by such rations is not attributable to the insufficiency of this accessory food factor (see table 1).

Effects of copra meal on reproduction and growth of young

Effect on reproduction. Owing to the apparent resistance of the albino rats to the toxic property of copra meal, the writer had an opportunity to study the effects on reproduction and the growth of suckling animals. A study that he was not able to make in the first part of the work with guinea pigs, because of the fatal effects of copra meal on these animals.

Table 2 shows that there is no marked difference in the number of young produced by the animals fed with the different rations. All (except those on ration 3) had the normal size of litters. (Donaldson, 1924.) As previously noted, the most apparent effect of rations with high percentage of copra meal seems to be in the tendency of such rations to cause premature bearing of young. This may be seen in table 2.

TABLE 2

Showing the effect of different percentages of copra meal on reproduction and well being of young

RATION	PARENTS	NO. OF YOUNG	BORN LIVING	BORN DEAD	DIED DURING EXPERIMENT	NO. REARED	REMARKS
1	No. 184 ♂ × No. 191 ♀	7	5	2	1	4	Not normal
	No. 184 ♂ × No. 134 ♀	7	7	0	3	4	Not normal
2	No. 132 ♂ × No. 144 ♀	6	4	2	2	2	Not normal
	No. 143 ♂ × No. 185 ♀	7	4	3	4	0	Not normal
2	No. 143 ♂ × No. 185 ♀	4	0	4	—	0	Not normal
	No. 133 ♂ × No. 186 ♀	6	4	2	1	3	Not normal
3	No. 190 ♂ × No. 142 ♀	3	0	3	—	0	Not normal
	No. 141 ♂ × No. 188 ♀	4	1	3	1	0	Not normal
4	No. 189 ♂ × No. 196 ♀	7	7	0	3 ^a	4	Normal
	No. 140 ♂ × No. 157 ♀	5	5	0	1	4	
5	No. 197 ♂ × No. 183 ♀	4	4	0	0	4	Normal
	No. 197 ♂ × No. 135 ♀	5	5	0	0	5	Normal
	No. 197 ♂ × No. 135 ♀	5	5 ^b	0	—	—	Normal
	No. 197 ♂ × No. 135 ♀	4	4	0	0	4	Normal

^a Death of the young was due to lack of water soluble B.

^b Accidentally killed.

The two animals on ration 3 produced one litter each, totalling seven. Six of these were born dead and the seventh died after a few days.

The three animals on ration 2 produced altogether 23 young, 11 of which were born either prematurely or dead. Of those that lived, seven died in the course of the experiment. The body appearance and condition of the young that lived were far from being normal. Of the 14 young born of the two animals, 191 ♀ and 134 ♀ on ration 1, eight were reared. These young were very much better in body condition than those on ration 2, but they were not normal as compared with those reared in the control lot.

Effect on the growth of young. To ascertain the rate of growth and the general body welfare of the young, produced and reared under different rations, the young were weighed, individually, weekly. General observations on their body welfare were also made. The experiment was started a few days after birth and was carried for a period of two months or more. Inasmuch as it is impossible to record individual food intake of suckling rats, they were fed in groups.

Among the animals fed with rations 5, 2, and 1, three litters of young were born at about the same time. A comparative study of the growth of these groups

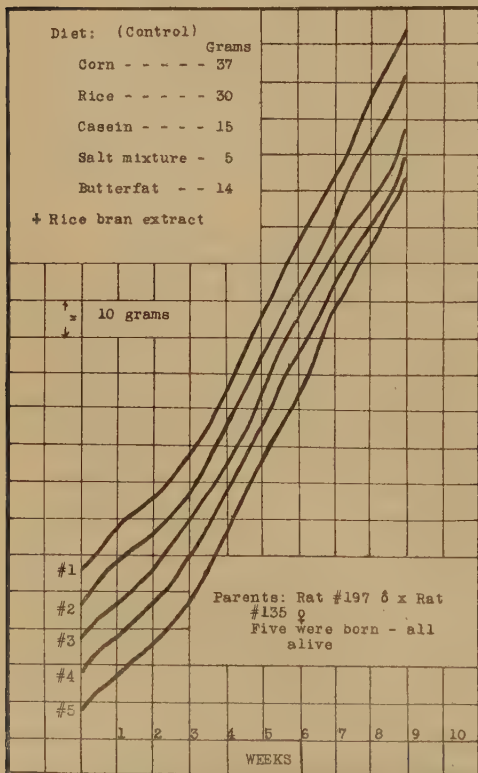


Chart 6.—Weight curves of five very young rats in a litter, showing their behavior as they were nursed and reared by rat No. 135 ♀, feeding on a complete ration which did not contain any copra meal.

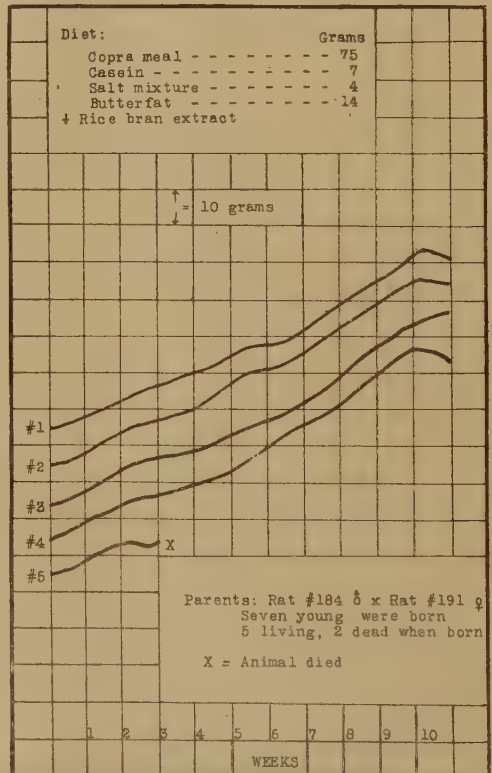


Chart 7.—Weight curves of five very young rats in a litter, showing their behavior as they were nursed and reared by rat No. 191 ♀, feeding on a complete diet which contained 75 per cent of copra meal.

of young will show that, even through the suckling period, the growth of young on rations 2 and 1 was far below the growth of those on control ration. Also, those in the control lot were very active and in good health, while those on rations 1 and 2 were emaciated and inactive. A number of those on ration 2, and two on ration 1, died. Those remaining were not in good health. (See table 2).

The foregoing comparative studies of the effect on growth and welfare of young were repeated. This time, litters on rations 5, 2, 1, and 4 were studied. The animals on ration 3 failed to produce young alive.

A study of the weight curves of the different groups from a few days after birth, until they were about 2 months old, will show that the growth of young on rations 2 and 1 was far below those of the control lot. The young on ration 1 exhibited better growth than those on ration 2. The growth of the young on ration 4 compared favorably with that of the control lot.

While all of the young on the control ration were normal, those on ration 2 showed ill body condition and were very weak. The animals on ration 4 showed normal health, vigor, and body condition.

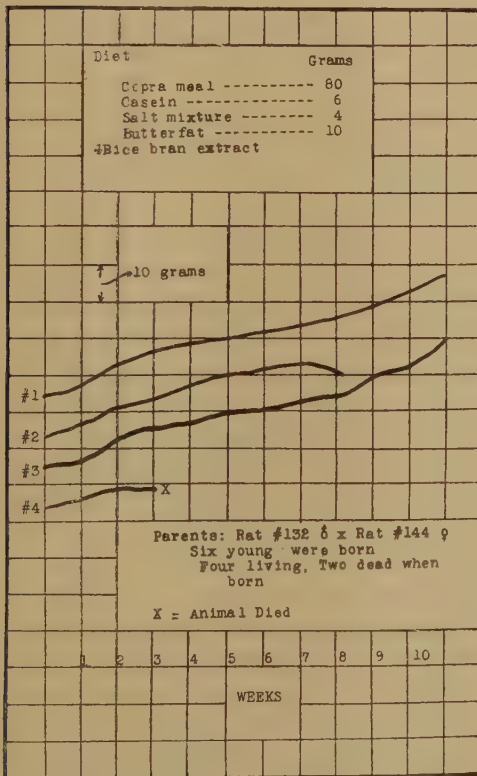


Chart 8.—Weight curves of four very young rats in a litter, showing their behavior as they were nursed and reared by rat No. 144 ♀, feeding on a complete diet which contained 80 per cent of copra meal.

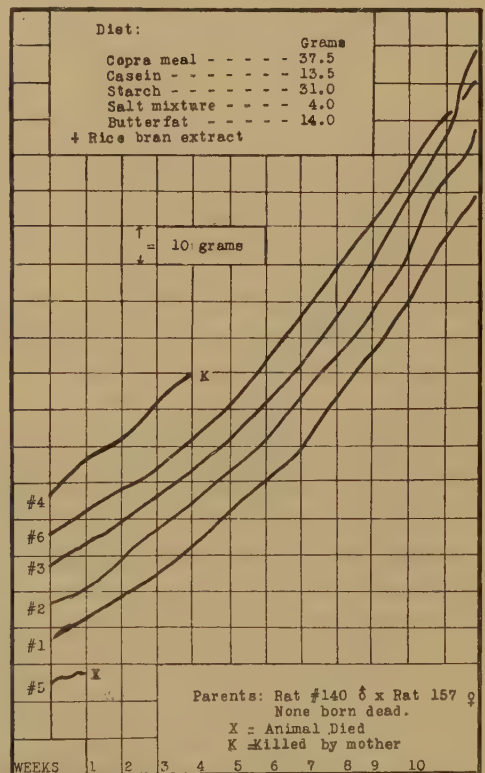


Chart 9.—Weight curves of five very young rats in a litter, showing their behavior as they were nursed and reared by rat No. 157 ♀, feeding on a diet which contained only 37.5 per cent copra meal.

DISCUSSION OF RESULTS

The results of these experiments show that the animals fed on a ration containing a high proportion of copra meal were very much inferior in body health to those in the control lot. They showed stunted growth, a highly emaciated condition and general inactivity.

Table 1 shows that this cannot be accounted for by differences in food intake, inasmuch as the animals on the experimental ration had just as much food intake as those on the control ration, for the same length of time. It may also be shown here that those animals which were fed with the ration containing 37.5 per cent copra meal and which compared favorably in growth, activity, and other manifestations of health with the control animals, had just about the same food intake.

Considering that the animals under the same conditions functioned to about the same degree in the rearing of young, and that they had about the same food intake, the inferior body condition and the stunted growth of the animals fed with rations containing large proportions of copra meal, may be attributed to the deleterious property of copra meal. Increased use of rice bran extract failed to produce better health and body condition or better growth of these animals.

It must be considered here that the control animal No. 135 ♀ produced and reared three litters of young without showing body emaciation, other abnormalities or stunted growth. The same may be said of the other control animal, No. 83 ♀, which raised a litter of young successfully and maintained normal body condition.

The results of these experiments tend to show that copra meal when used in large proportions in the ration is deleterious to albino rats. It affects these animals by inhibiting growth and producing marked body emaciation, inactivity, and other abnormalities. Females seem to be affected more than the males.

Table 2 shows the different litters of young born in the different lots, the size of the litters, the number of young born dead or living, the number reared, and the number that died during the experiment. As stated before, there is no appreciable difference in the size of the litters in the different lots. It may be seen, however, that the number of young born dead is rather high among the animals on rations with high proportion of copra meal, while there is no death recorded among the animals in the control lot or among those feeding on a ration low in copra meal. In this connection, King (1921), as cited by Donaldson (1924), after a study covering a period of five years reported that "only a small number are born dead in case of normal mothers. Where abnormal conditions exist the number of dead born may be high." The high number of young born dead in these experiments may be attributed to the deleterious property of copra meal.

The number of young that died during the course of the experiment is also appreciably high among the animals on rations with high proportion of copra meal, while none in the control lot died. Death of some of the young in the ration with low percentage of copra meal may be attributed, as explained elsewhere in this paper, to lack of vitamin B. Striking differences were shown by the young animals in the control lots and those in the others. While those on rations with high proportions of copra meal were highly emaciated, inactive, and had stunted growth, those in the control lot and on ration with low percentage of copra meal were apparently healthy, active, and showed normal growth.

(See charts 6, 7, 8 and 9.) Results of these experiments seem to show that high proportions of copra meal in the ration affect the reproduction of the animals and the well-being of their young. The effect is manifested in the high number of young born dead and in the failure of the young animals to grow normally.

SUMMARY OF CONCLUSIONS

When copra meal forms from 75 to 85 per cent of an otherwise complete ration, it is deleterious to albino rats. The most important manifestations are stunted growth, emaciation, inactivity, and weakness. The effect is not fatal.

When copra meal is present in low percentage in the ration (about 37.5 per cent) and properly supplemented with vitamin B, it is promotive of health, vigor, normal growth, and normal reproduction of albino rats.

High proportions of copra meal seem to produce a large number of young born dead. Growth of very young rats is, to a large extent, stunted. Emaciation, weakness, and other abnormalities are manifested, which sometimes increase until death results.

ACKNOWLEDGMENT

The writer acknowledges his obligations to Dr. Manuel L. Roxas, Professor and Head of the Department of Agricultural Chemistry, at whose suggestion this work was undertaken, for his valuable criticisms during the progress of the work; also to Dr. F. O. Santos, Assistant Professor in the same Department for suggestions and criticisms.

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DAIRY MANAGEMENT OF NATIVE COWS¹

VALENTE VILLEGAS AND DANIEL B. PEÑA

Of the Department of Animal Husbandry

One of the factors determining the success of a dairy is the source of supply of animals. As a general rule, it is sound policy to secure dairy cows locally. With this point in view, the writers started work with the object of finding whether or not it is practicable to use native cattle for dairy purposes.

The principal aim in the investigation was to determine the comparative period of lactation, milk production, and fat test between cows treated according to the approved system of dairy management and those subjected to the native method of handling dairy animals.

The investigation was conducted at the College of Agriculture, Los Baños. It covered a period of about two years and eleven months—from December 14, 1922, to November 11, 1925.

COWS

Six cows, typically native in conformation and color, as well as in size, were used. Their weight ranged from 238 to 320 kilograms. The majority of them were medium in age. Sampaga was the youngest, being approximately 3½ years old, while Mama was apparently the oldest (see tables 1 and 2). Mama was, however, thrifty and vigorous during the experiment.

BARNs AND PENS

The cows were brought to the barn at milking time. They were placed in stanchions, and grain was given to them in the manger before and during milking.

Weaned calves and those temporarily separated from their dams were placed in pens 4×5 meters in size. Feed racks and boxes were used in feeding and salting in the pens.

CONCENTRATES

A grain mixture, containing two parts of rice bran and one part of copra meal, by weight, was used for the cows. At times, ground corn was added to give variety and palatability to the ration. A similar combination was given to the calves.

PASTURES

The roughage feed of the animals was largely supplied from the pastures. The calves in the pens were the only animals that were given cut forage, which was mostly Guinea grass (*Panicum maximum* Jacq.). The pasture grasses con-

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Mr. Peña, junior author, was formerly graduate assistant in Animal Husbandry in the College of Agriculture.

sisted principally of cogon (*Imperata cylindrica* (L) Beauv.), talahib (*Saccharum spontaneum* L. subsp. *indicum*), culape (*Paspalum conjugatum* Berg.), and aguiñgay (*Rottbælia exaltata* L. f.).

MANAGEMENT

General

The cows lived under natural and favorable environment. Great economy in handling was secured by turning them loose in the pastures after they were milked in the barn, thus letting them get their roughage supply themselves. They had access to a plentiful supply of very palatable, succulent grass of different species.

The feeding of concentrates to the cows was gauged by the condition of the animals as well as production records. Inasmuch as the production was comparatively low and the cows apparently in good condition, very little grain was fed to them. Whatever grain feed was given was on the basis of one kilogram of grain for every three kilograms of milk produced daily.

The animals were salted regularly three times a week.

Native system

The main differences in management of dairy animals by the native method and by the approved system are in the raising of calves and frequency of milking.

Under the native system of management the calves are allowed to go with the dams in the daytime but are corralled separately from them in the evening. This plan enables the mothers to store milk to be milked the next morning. Ordinarily, this procedure is continued until the cows are dry. But in the work here reported a modification of management was introduced so as to obtain the greatest possible milk production. That is, as soon as the calves were old enough to subsist on grain and forage they were completely weaned from their dams so as to materially increase the milk production of the cows. On an average the calves were weaned at 122.5 days of age (see table 2). On account of their poor condition, Inasaran's and Sampaga's calves were not weaned.

While the calves were following their dams, milking was done only in the morning, but after separating the calves from their mothers, milking was done morning and evening.

The raising of calves while following their dams was simple. When they were with their dams they subsisted mainly on the mother's milk and when corralled, they were supplied with grain and grass. A standard mixture of three parts rice bran, two parts copra meal, and one part ground corn, by weight, was given to the calves in the pens in amounts that they consumed readily in a short time. Salt and charcoal were placed before them in the pens.

Approved system

Under the approved system of dairy management the raising of calves was more complicated and difficult. The calves were separated from their dams three to five days after freshening. At the start, attention was centered on teaching the calves to drink milk from the pail. The attendant first made them familiar with the pail as a source of food by putting a finger in the milk and getting the calf to suck it. Very soon the calf would drink the milk without this aid.

Whole milk was supplied to them three times a day, giving them, daily, about three kilograms a head. This amount was maintained until the calves were ten days old, after which the supply was decreased gradually to about two kilograms, fed twice daily. Supplementary to milk feeding, the calves were furnished grain and fine grass. Salt and charcoal were placed before the calves at all times. These calves grew well until they were old enough to be turned out in the pasture.

From the beginning until the end of lactation the cows were milked, morning and afternoon.

TABLE 1

Showing period of lactation, milk production, and fat test of cows treated according to approved system of management

COW	PERIOD OF LACTATION	MILK PRODUCTION	FAT TEST
	<i>days</i>	<i>liters</i>	<i>per cent</i>
Mama.....	168	19.0	3.1
Dampalit.....	168	16.6	3.2
Liberty.....	122	28.9	4.8
Runaway.....	47	5.5	4.6
Average.....	126	17.5	3.9

TABLE 2

Showing age of the calf when weaned, period of lactation, milk production, and fat test of cows treated according to the native system of management

COW	AGE OF CALF WHEN WEANED	PERIOD OF LACTATION	MILK PRODUCTION	FAT TEST
	<i>days</i>	<i>days</i>	<i>liters</i>	<i>per cent</i>
Liberty.....	123	191	397.0	4.3
Liberty.....	122	179	222.3	3.8
Sampaga.....	—	188	198.9	3.4
Inasaran.....	—	194	219.8	4.0
Average.....	122.5	188	259.5	3.9

DISCUSSION OF RESULTS

Lactation period

According to table 1, the lactation period of four cows treated according to the approved system of dairy management varied from 47 to 168 days, giving an average of 126 days. Looking over table 2, it may be seen that the lactation period of the three cows handled according to the native method of management was longer, ranging from 179 to 194 days, the average being 188.

The difference in the length of the lactation period between the two groups of cows as influenced by the methods of handling is more evident in cow Liberty which was used in both groups. According to the approved system of dairy management this cow milked for 122 days, while according to the native method she milked for 191 and 179 days in two separate periods.

The very short lactation period, 47 days (see table 1), of the cow Runaway, was mainly due to her restless and wild disposition during the experiment.

Milk production

Table 1 shows that the cows subjected to the approved system of dairy management produced, on the average, 17.5 liters of milk, for the whole lactation period. The range in production was from 5.5 to 28.9 liters. This quantity is very much lower than the production of the cows handled according to the native method. The production of the cows under this system was, on the average, 259.5 liters, the minimum being 198.9 and the maximum, 397.0 liters.

Here, again, the difference in production of the cows as influenced by the system of management was more significant in the case of cow Liberty which was subjected to both methods of treatment. Under the approved system of management this cow produced only 28.9 liters, while under the native method she produced 397.0 and 222.3 liters in two separate lactation periods.

The extraordinarily low production of cow Runaway was, a short lactation period, due to her nervous restlessness during the experiment.

Fat test

A weekly sample of a composite of the milk of all the cows was preserved by adding a few drops of formaldehyde. These samples were analyzed for fat, using the Babcock method of analysis.

Table 1 shows that the fat test of the milk of the four cows treated according to the approved system of dairy management is on the average 3.9 per cent, the range being from 3.1 to 4.8 per cent. Comparing these figures with the tests of milk from cows managed according to the native method it may be seen that the average is the same, or 3.9 per cent (see table 2). The test in the latter case varied from 3.4 to 4.3 per cent.

It was not expected that the fat percentage of milk from cows of the two groups would be influenced by the methods of handling used. Any significant variation in test may be attributed to individuality rather than as a result of the system of management.

The relative figures are as follows:

	<i>Approved method</i>	<i>Native method</i>
Lactation period.....	126 days	188 days
Milk production.....	17.5 liters	259.5 liters
Fat test.....	3.9 per cent	3.9 per cent

SUMMARY

1. Two methods of dairy management were tried; namely, the native system and the approved. It was found that the native system of dairy management was more efficient than the approved method in the management of common native cows, both as to the length of the lactation period and the total yield of milk and fat.

2. The native cow, by any system of management tried, ranks very low as a dairy animal. Even where the price of milk is relatively high, as it is in the Philippines, it is doubtful whether the native cow, in her present status of breeding, can be milked with profit.

3. Following the approved system of dairy management, calves which were weaned soon after freshening were reared successfully until they were old enough to be turned out in the pasture.

PROPAGATION OF THE LANZON BY MARCOTTAGE AND BY CUTTINGS¹

DIONISIO C. POLO

INTRODUCTION

Since the earliest times the lanzon (*Lansium domesticum* Correa) has been propagated by the Filipino growers by means of seeds only. The practice of asexual, or vegetative methods of propagation has not met with much success, although in a very few cases, air-layering, or marcottage has been used.

If the lanzon could be propagated on a large scale by vegetative means, seminal variability would be avoided, and a tree which bears fruits of uniform type and superior quality could easily be perpetuated without loss of its desirable characters, except as influenced by the stocks and other minor factors. Moreover, trees propagated by means of seeds require a very much longer time before they come into bearing than those propagated asexually. Seedling trees of lanzon usually come to bearing between 10 and 15 years from the time of planting. It is not definitely known how long it would take trees, propagated vegetatively, to begin bearing, but it is well known that this practice greatly advances the bearing age of all trees.

Because of the very long time lost in waiting for seedlings to bear and because of their variability, the importance to the orchardist of the problem of developing rapid and efficient means of asexual propagation of lanzon cannot be over-estimated.

Review of literature

The literature on this subject is very meager. Not much has been done in this College to propagate lanzon asexually. Miraflores (1915), a former student of this College, tried marcottage, and cuttings of the lanzon. He made several trials to root lanzon cuttings but reported no success, no cuttings having made roots. In marcotting, however, he was successful. He reported that the rooting of the marcots required 134 days from the time of setting. Mendiola (1922) stated that trials of budding had been practical failures. He records also that attempts were made to graft lanzon on seedlings of santol (*Sandoricum koetjape* (Burn. f.) Merr.), but no success was attained although these two species belong to the same family. Wester (1920) recommends cleft or side grafting. He advises the use of a well matured cion but not too old, preferably six to eight centimeters in length and about one centimeter in diameter, to be inserted in a stock six to ten centimeters above the ground. He does not record what percentage of union has been effected by this method.

Curtis (1918) at Cornell University tried various chemical compounds to induce root growth in cuttings of difficult subjects. His experiments were carried

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on with California privet (*Ligustrum ovalifolium*) and a number of other woody plants. It was found that treatments with potassium permanganate gave beneficial results. There was "a marked increase in growth of various woody cuttings". For this behavior the following five possible explanations are suggested by this authority: (1) "That the treatment causes a change in the nature of the food supply of the twig, (2) that it affects the rest period of the cuttings, (3) that it upsets the balance of food supply in favor of the roots, (4) that it retards or inhibits growth of microorganisms, and (5) that it increases respiratory activity by catalytically hastening oxidation. The last of these explanations is considered most probable. Root growth is considered to be largely independent of the rest period, buds, but not the whole stem, assuming the resting condition".

In an unpublished experiment of Sabado, formerly of this College of Agriculture, in testing tropical plants by the methods of Curtis, a similar result was obtained by using potassium permanganate solution as a stimulant to root growth of cuttings of different species. Gonzalez (1925) of the Department of Agronomy of this College tried ether potassium permanganate on avocado cuttings, but, at the time of publication of his paper, the results on these phases of his work were not known.

Objects of the present work

The objects of the present work were: (a) To determine the possibilities of propagating the lanzon by marcottage and by cuttage; (b) To determine the effect of potassium permanganate (KMnO_4) solution on the root formation in marcots and in cuttings.

Time and place of the present work

The work here described covered a period of 16 months from September, 1923, to December, 1924. It was carried out in the nursery of the College of Agriculture, Los Baños, Laguna.

For the purpose of continuity and clearness, the different methods of propagation, with the experiments performed, will be discussed separately.

MARCOTTAGE

As has been said, marcottage, one of the oldest methods of vegetative propagation, has been used successfully with many trees and in a few instances with the lanzon. The Filipino fruit grower is quite familiar with the process and uses it almost exclusively in propagating the chico (*Achras sapota* L.), but has attained little success in its application to the lanzon. Marcottage is performed by ringing a branch or twig while it is still attached to the parent plant and then applying soil to the ringed section to induce root formation.

MATERIALS AND METHODS

Potassium permanganate solutions of different concentrations, varying from 1 per cent to 30 per cent, were used in marcottage. The preparation of the solutions was very simple. A quantity of known weight of the potassium permanganate crystals was dissolved in a known volume of tap water. The volume of solution prepared for each experiment was 1000 cubic centimeters, that is, 10 grams were dissolved in 1000 cc. of water to make 1 per cent solution. The solutions were placed in bottles holding 1 liter each, kept air-tight and ready for use.

In the work here described, branches similar in size and condition, with a diameter of about $1\frac{1}{2}$ centimeters, were used. Each branch was completely girdled removing about three centimeters of bark at the point desired. A piece of absorbent cotton saturated with potassium permanganate solution was applied to the girdle. To prevent rapid oxidation of the solution and to keep it from being washed away by moisture or rain, the treated section was inclosed with a piece of thin oil-paper about 25 centimeters wide and 30 centimeters long. Both ends of the paper were tied with string, close to the tree, to keep the paper from slipping down. The treated branches were allowed to remain in this condition for about 24 hours, after which the cotton was removed. The fiber of *cabo negro* (*Arenga saccharifera* (Wurmb.) Labill.), was wrapped around the treated, or girdled section of the branch inclosing ordinary clay loam soil as a medium to induce root formation. The soil covered the girdled portion and five centimeters above and below it. Fine wire was tied firmly around the *cabo negro* fiber to hold it in place and keep it compact, and to afford greater security.

EXPERIMENTS AND RESULTS

Three series of experiments in marcottage were conducted at different times of the year. The first series in which 80 branches were used was begun in January, 1924. There were eight treatments in all, including a check, and for each treatment 10 branches were used. After ringing, all branches except those used for a check were treated with potassium permanganate solutions of varying degree of concentration. The potassium permanganate solutions used were as follows: 1 per cent, 5 per cent, 10 per cent, 15 per cent, 20 per cent, 25 per cent, and 30 per cent.

The ringing of the branches and the application of the solutions was performed on January 20, 1924, and the medium was applied 24 hours later. Labels were attached to each marcot, indicating the number, date, and concentration of solution.

In order to determine the effect of potassium permanganate treatments all the marcots were examined after three weeks had elapsed from the time of setting them, and then once every two days until all had formed roots. Every marcot which had formed roots was marked with letter *R* with the corresponding date of observation. Those marcots marked with *R* were not examined again, thus avoiding disturbance of the roots just formed, and also saving time and labor.

The results obtained in this experiment are given in table 1.

The second experiment was begun on August 10, and the third on August 13, 1924. The second experiment was a repetition or rather duplication of the first, hence, they are the same in nature except that the second was performed during the rainy season. As shown in table 2, the results are similar to those obtained in the first experiment but with less marked effects of the treatment during the rainy season when roots seem to form readily in many plants. The third experiment differed from the first and second in the medium used to receive the roots, sphagnum moss being employed. The moss was immersed in the solutions and immediately applied to the girdled branch. Five branches were used for each treatment. Otherwise the method and procedure were the same throughout as in the

first and second experiments, except that absorbent cotton and glazed paper were not used.

About 100 days from the time of setting, the roots of some of the marcots appeared at the surface of the medium and the tips of the roots which had penetrated to the surface dried as soon as they were exposed to the air, owing to heat of the sun and the absence of moisture supply. So the marcots which had formed sufficient roots to support the new plant were severed from the parent branch and planted in the nursery in rows about 50 centimeters apart in the row and one meter between the rows. In planting, a portion of soil 30 by 30 by 30 centimeters was dug out and replaced with surface soil. A good portion of the top and leaves of the marcots was removed to reduce, as much as possible, the area of transpiration. The marcots were planted with care so that the roots would not be injured. Watering was done immediately after the planting so as to keep the soil around the new plant moist and compact.

Fifty rooted marcots were planted in the nursery rows. The first planting was on August 1, 1924, in which 25 marcots were used. None of these marcots died. On October 10, 1924, another 25 marcots were planted. These all lived, making 100 per cent success in the transferring of the 50 marcots to the open ground.

TABLE 1

First experiment: showing the effect of potassium permanganate solutions in root formation of the lanzon marcots in clay loam soil. Performed on January 20, 1924

NO. OF BRANCHES USED	TREATMENT	DATE WHEN FIRST ROOT APPEARED	MIN. NO. OF DAYS TO ROOT	DATE WHEN LATEST MARCOT ROOTED	MAX. NO. OF DAYS TO ROOT	AV. NO. OF DAYS	NO. OF BRANCHES ROOTED	PERCENTAGE
10	Check	Mar. 12, 1924	52	Mar. 28, 1924	68	59.4	10	100
10	1 per cent	Feb. 29, 1924	40	Mar. 16, 1924	56	48.6	10	100
10	5 per cent	Feb. 29, 1924	40	Mar. 14, 1924	54	47.6	10	100
10	10 per cent	Feb. 29, 1924	40	Mar. 14, 1924	54	47.2	10	100
10	15 per cent	Feb. 27, 1924	38	Mar. 12, 1924	52	45.2	10	100
10	20 per cent	Feb. 21, 1924	32	Mar. 2, 1924	42	38.0	10	100
10	25 per cent	Feb. 21, 1924	32	Mar. 16, 1924	56	45.2	10	100
10	30 per cent	Feb. 23, 1924	34	Mar. 20, 1924	60	47.6	10	100

DISCUSSION OF RESULTS

First experiment

Table 1 shows that in every case there was 100 per cent success, that is, both the treated and the untreated marcots formed roots. The untreated branches, however, required longer periods for rooting than the treated ones. The first untreated marcot that formed roots required 52 days from the time of preparation; all the marcots in the check (untreated) rooted within 68 days.

In the case of the treated branches there was a variation in the period of rooting even in the individual treatments. In the 1 per cent, 5 per cent, and 10 per cent treatments, the first marcots that formed roots required 40 days; the 15 per cent treatment required 38 days; the 20 per cent and 25 per cent treatments each required 32 days; and the 30 per cent treatment, 34 days. To form roots on all the marcots the 1 per cent treatment required 56 days; the 5 per cent treatment required 56 days; the 5 per cent, 54 days; the 10 per cent, 54 days; the 15 per cent, 52 days; the 20 per cent, 42 days; the 25 per cent, 56 days; and the 30 per cent, 60 days.

A comparison of the number of days required for all the marcots to strike root shows that potassium permanganate treatment hastened the rooting of the marcots. However, as the concentrations of the solutions were increased from 1 per cent to 20 per cent, the period required for rooting gradually decreased or shortened; beyond 20 per cent the results were reversed, the period of rooting being lengthened.

With the different treatments the average number of days required for all branches to form roots was: 48.6 days with the 1 per cent solution; 47.6 days with the 5 per cent and 30 per cent solutions; 47.2 days with the 10 per cent solution; 45.2 days with the 25 per cent solution; 38 days with the 20 per cent solution; and 59.4 days with the check, with no treatment. The shortest period was with the 20 per cent solution treatment and the longest with the check, that is, no treatment.

TABLE 2

Second experiment: showing the effect of potassium permanganate solutions in root formation of the lanzon marcots in medium clay loam soil. Performed on August 10, 1924

NO. OF BRANCHES USED	TREATMENT	DATE WHEN FIRST ROOT APPEARED	MIN. NO. OF DAYS TO ROOT	DATE WHEN LATEST MARCOT ROOTED	MAX. NO. OF DAYS TO ROOT	AV. NO. OF DAYS	NO. OF BRANCHES ROOTED	PERCENTAGE
10	Check	Sept. 13, 1924	34	Sept. 21, 1924	42	37.6	10	100
10	1 per cent	Sept. 13, 1924	34	Sept. 21, 1924	42	37.4	10	100
10	5 per cent	Sept. 13, 1924	34	Sept. 19, 1924	40	36.6	10	100
10	10 per cent	Sept. 11, 1924	32	Sept. 19, 1924	40	35.8	10	100
10	15 per cent	Sept. 11, 1924	32	Sept. 19, 1924	40	35.8	10	100
10	20 per cent	Sept. 7, 1924	28	Sept. 17, 1924	38	36.6	10	100
10	25 per cent	Sept. 11, 1924	32	Sept. 19, 1924	40	36.2	10	100
10	30 per cent	Sept. 13, 1924	34	Sept. 21, 1924	42	37.8	10	100

Second experiment

This experiment was the same in character as the first experiment in the use of potassium permanganate in marcottage. The results obtained are given in table 2. In general, these results agree with those of the first experiment, only there were less marked differences between the treated and the untreated branches in the number of days required for the marcots to form roots. With the different treatments, there were required for the appearance of the first root formation; 34 days with the 1 per cent, the 5 per cent, and the 30 per cent treatments; 32 days with the 10 per cent, the 15 per cent, and the 25 per cent treatments; and 28 days with the 20 per cent treatments. On the whole, the difference in time was small. As in the first experiment the shortest period for forming roots was with the 20 per cent solution. Some of the untreated branches rooted in 34 days, the same period required in the cases of the 1 per cent, 5 per cent, and 30 per cent solutions. The other branches of the check required longer time.

The highly favorable conditions for natural root formation which exist during the rainy season may be the reason for the root forming periods in the second experiment being so nearly equal. As might be expected, beneficial effects resulting from the use of potassium permanganate were less marked at that season when root formation is active.

With the exception of the 30 per cent treatment, all the other treated lots, on an average, rooted earlier than the untreated marcots. The untreated mar-

cots required an average of 37.6 days and the 30 per cent treatment required 37.8 days, practically the same. The maximum beneficial effects were attained by the use of a twenty per cent solution.

TABLE 3

Showing results of the use of different concentrations of potassium permanganate solutions in sphagnum moss^a as medium for marcotting lanzon. Performed on August 13, 1924.

NO. OF BRANCHES USED	TREATMENT	DATE WHEN FIRST ROOT APPEARED	MIN. NO. OF DAYS TO ROOT	DATE WHEN LATEST MARCOT ROOTED	MAX. NO. OF DAYS TO ROOT	AV. NO. OF DAYS	NO. OF BRANCHES ROOTED	PERCENTAGE
5	Check	Sept. 16, 1924	34	Sept. 24, 1924	42	36.4	5	100
5	1 per cent	Sept. 14, 1924	32	Sept. 20, 1924	40	33.2	5	100
5	5 per cent	Sept. 8, 1924	26	Sept. 22, 1924	40	32.4	5	100
5	10 per cent	Sept. 6, 1924	24	Sept. 22, 1924	40	32.8	5	100
5	15 per cent	Sept. 10, 1924	28	Sept. 20, 1924	38	33.6	5	100
5	20 per cent	Sept. 8, 1924	26	Sept. 22, 1924	40	34.4	5	100
5	25 per cent	Sept. 14, 1924	32	Sept. 18, 1924	36	35.6	5	100
5	30 per cent	Sept. 14, 1924	32	Sept. 20, 1924	38	37.6	5	100

^a The sphagnum moss was immersed in the solutions and applied immediately to the girdled branches.

Third experiment

Table 3 shows the results of the use of different concentrations of potassium permanganate solutions in sphagnum moss as a medium to receive the roots. The moss was treated with the solutions and allowed to remain upon the branch. As in the first and second experiments the period of rooting varied in each treatment. The check, or untreated marcots made roots in 34 to 42 days from the time of setting, with an average of 37.6 days. With the different treatments the average number of days required for all branches to form roots was: 36.4 days with 1 per cent solution; 35.6 days with 30 per cent; 34.4 days with 25 per cent; 33.6 days with 20 per cent; 33.2 days with 5 per cent; 32.8 days with 15 per cent; 32.2 days with 10 per cent. In general, the untreated marcots required longer periods for rooting than those treated. It was also found that branches treated with 10 per cent solution rooted sooner than any of the other treatments, requiring on the average 32.2 days.

The results obtained are in accordance with those found in the other two experiments except that the optimum effects from the use of the potassium permanganate were here attained with weaker solutions. Where the solutions were applied for limited periods, as in the other two experiments, the maximum benefits were obtained from the use of 20 per cent concentration. But the results obtained in the third experiment, where the solution was applied to the rooting medium and left there, show that those that were treated with 10 per cent, 15 per cent, and 5 per cent solutions, rooted in shorter periods than with the other concentrations. This is not surprising, as the weaker solutions continued longer had the same effect as the stronger solution applied for a briefer period. The results show that by proper concentrations in the sphagnum moss as a medium the rooting period of the marcots is much shortened.

CONCLUSIONS

From the results obtained in this study the following conclusions may be drawn:

1. The lanzon can be propagated asexually by means of marcottage. One hundred per cent success was attained in every treatment.

2. Potassium permanganate solutions of correct concentration produce beneficial effects in root formation in marcottage. Marcots treated with such solutions rooted more rapidly than the untreated ones. The rooting in the case of the treated branches required from 28 to 60 days from the time of setting, and in the case of the untreated branches the rooting required from 34 to 68 days.

3. In marcottage, from 10 to 20 per cent potassium permanganate solutions applied for 24 hours immediately before applying the soil, hastened root formation. But marcottage properly performed may be expected to result in a very high degree of success without any chemical treatment. Higher concentrations of the potassium permanganate solutions gave less marked results in stimulating root growth. Weaker solutions may be applied longer and stronger solutions not so long.

4. After about 100 days from the time of setting the marcots they are ready to be severed from the parent plant and can be planted immediately in the nursery rows or in the permanent field with success, provided that good care and attention are given them, especially in suitably cutting back and in the application of water during and after transplanting, if rain is not abundant.

CUTTAGE

Cuttage is the process of propagating plants by cuttings, or severed parts. Next to seedage, it is probably the most widely known and the simplest of the methods of plant propagation.

According to the experience of previous workers along this line, the lanzon does not readily respond to propagation by cuttings. The writer, with a view to devising ways and means by which cuttage might be successfully applied to the propagation of the lanzon, conducted experiments with certain modifications in method, especially testing the effects of the use of permanganate of potash as a possible stimulant to root development.

MATERIALS AND METHODS

In this work, five beds 180 centimeters by 50 centimeters with a depth of 25 centimeters were prepared under the shade of trees by digging out a considerable portion of the soil and then replacing it with enough medium coarse fresh water sand. The sand was leveled and packed firmly with a spade. An advantage of this medium is that it drains easily and is therefore well aërated. Also, it has less decaying organic matter in which there may be fungi and bacteria which are injurious to unrooted cuttings. Rich soil is not only unnecessary for cuttings without roots but may be injurious. When the beds were ready, the preparation of the cuttings followed.

Wood of well matured growths was used but none that was large or old. With pruning shears, the branches were cut into pieces about 15 centimeters long. The leaves were trimmed off close to the stem, and both ends of the cuttings were prepared with a smooth slanting cut using a sharp knife and taking care not to bruise the wood. The cuttings were then placed in porcelain jars having a capacity of 1000 cc. Two hundred cubic centimeters of potassium permanganate solution of the desired concentration were poured into each jar, immersing about two centimeters of the basal ends of the cuttings in the solution. The ends of the cuttings were kept immersed in 0.5 per cent, 1 per cent, 1.5 per cent, 2 per cent, and 3 per cent potassium permanganate solution for periods vary-

ing from 12 to 48 hours. In those cases where the immersion was continued longer than 24 hours the solution was renewed at the end of this period. For each concentration used the periods of immersing the cuttings were 12 hours, 24 hours, and 48 hours, after which they were set in the beds.

In setting the cuttings, to avoid bruising of the ends, as much as possible, a hole, the desired depth, was first made in the sand medium, with a round piece of wood about two centimeters in diameter. The cuttings were placed in the holes about two thirds of their length, in a slanting position. Then, to keep them in position, the sand around the cuttings was pressed gently.

FIRST EXPERIMENT AND RESULTS

Three experiments with lanzon cuttings were conducted at different times of the year. The first of these experiments was begun on December 22, 1923, the second on April 7, 1924, and the third on August 29, 1924.

The beds in these experiments were numbered from 1 to 5. In each bed a check was used consisting of 60 cuttings set together with the treated ones. Cuttings treated with 0.5 per cent, 1 per cent, 1.5 per cent, 2 per cent, and 3 per cent potassium permanganate solutions as described above under "Materials and Methods," were set in beds Nos. 1, 2, 3, 4, and 5, respectively. Sixty cuttings were used for every period of exposure to the solution in each treatment so that all together 240 cuttings were set in one bed or 1,200 cuttings in all of the five beds used in the first experiment.

Before setting the cuttings in the beds, water was applied to the sand to keep it moist. During the experiment, water was applied as often as necessary.

The cuttings of the first experiment were examined on March 15, 1924, about four months after the time of setting, and the number which had formed roots was determined.

TABLE 4

First experiment: showing the effect of potassium permanganate solutions on the root formation in lanzon cuttings. The cuttings were set December 22-24, 1923, and examined on March 15, 1924.

TREATMENT	LENGTH OF SOAKING THE CUTTINGS	NO. OF CUTTINGS USED	NO. OF CUTTINGS ROOTED	PERCENTAGE
Check	—	60	3	5.00
0.5 per cent	12 hours	60	3	5.00
	24 hours	60	11	18.33
	48 hours	60	13	21.66
Check	—	60	2	3.33
1.0 per cent	12 hours	60	15	25.00
	24 hours	60	20	33.33
	48 hours	60	13	21.66
Check	—	60	20	33.33
1.5 per cent	12 hours	60	32	53.33
	24 hours	60	20	33.33
	48 hours	60	19	31.66
Check	—	60	None	None
2.0 per cent	12 hours	60	30	50.00
	24 hours	60	26	43.33
	48 hours	60	23	38.33
Check	—	60	5	8.33
3.0 per cent	12 hours	60	11	18.33
	24 hours	60	8	13.33
	48 hours	60	5	8.33

Table 4 gives in detail the results obtained in the first experiment, showing the effect of potassium permanganate solutions on the root formation in the lanzon cuttings. For purposes of comparison between the treated and the untreated cuttings (the check), the rooted cuttings in all the checks running simultaneously were taken together and the average was used as the standard for comparison.

Transplanting

Cuttings which had formed a root system considered sufficient to support the new plants were transplanted in the nursery rows. Planting was done during the early part of August, 1924. Thirty cuttings were set in the nursery. Immediately after transplanting, the cuttings were shaded with light materials or banana to protect them from the intense heat of the sun. The covers were removed gradually so as to adapt the new plant to the natural conditions. Water was applied whenever necessary to keep the soil around the plant moist. Cultivation and weeding were done occasionally during the experiment.

Of the 30 cuttings planted in the nursery, 10 died, and 20 are growing, thus making a little over 66 per cent success in transferring them to the open land. It is now believed that much less loss would have been sustained if the cuttings could have been left to develop longer roots before transplanting.

DISCUSSION OF RESULTS

First experiment

As shown in table 4 there was a greater percentage of cuttings that rooted when treated with potassium permanganate solutions than when there was no treatment at all. A number of cuttings in the checks made roots, although most of them made callus but did not strike roots.

In check No. 1, 5 per cent of the cuttings formed roots; in check No. 2, 3.33 per cent; in check No. 3, 33.33 per cent; in check No. 4, none; and in check No. 5, 8.33 or an average of 10 per cent for all the untreated cuttings.

Results with 0.5 per cent solutions. Of the treated cuttings, the results show that for the treatment with 0.5 per cent solution there were 5 per cent of the cuttings which formed roots after 12 hours' exposure or 5 per cent less than that of the check; with 24 hours, 18.33 per cent or 8.33 per cent over that of the check; with 48 hours, 21.66 or 11.66 per cent over that of the check.

Results with 1 per cent solutions. With a 1 per cent solution applied for 12 hours, 25 per cent of the cuttings formed roots or 15 per cent over that of the check; with 24 hours, 33.33 per cent rooted or 23.33 per cent over that of the check; with 48 hours, 21.66 per cent or 11.66 per cent more than the check.

Results with 1.5 per cent solutions. With 1.5 per cent treatment for 12 hours, 53.33 per cent of the cuttings formed roots or 43.33 per cent over that of the check; with 24 hours, 33.33 per cent or 23.33 per cent over the check; with 48 hours, 31.66 per cent or 21.66 per cent over the check.

Results with 2 per cent solutions. With the treatment in 2 per cent solution for 12 hours, 50 per cent rooted or 40 per cent over the check; for 24 hours, 43.33 per cent or 33.33 per cent over the check; and for 48 hours, 38.33 per cent or 28.33 per cent over the check.

Results with 3 per cent solutions. With the treatment in 3 per cent solution for 12 hours, 18.33 per cent rooted or 8.33 per cent over the check; for 24 hours, 13.33 per cent or 3.33 per cent over the check; and for 48 hours, 8.33 per cent or about 1 per cent below the check.

It is further shown that as the concentration of the solution was increased from 0.5 per cent to 2 per cent there was a gradual increase in the percentage of rooted cuttings, but as the concentration went beyond 2 per cent, a decrease of the percentage of rooted cuttings followed. This indicates that solutions higher than 3 per cent concentration affected root growth in the cuttings adversely. The 2 per cent treatment gave the highest percentage of rooted cuttings, followed by 1.5 per cent, 1 per cent, 0.5 per cent, and 3 per cent in the order given.

Considering the periods of exposure it is seen that in 0.5 per cent treatment, 48 hours gave the highest percentage of rooted cuttings, 21.66. In 1 per cent treatment, 24 hours proved to be the most effective period of exposure, giving 33.33 per cent. In the 1.5 per cent, 2 per cent, and 3 per cent solutions, 12 hours exposure gave the best results. This shows that as the concentration of solution is increased, the period of exposure should be shortened.

In general, potassium permanganate treatment of suitable concentrations and of correct exposures gave beneficial results on the root growth of cuttings. A greater percentage of cuttings rooted when treated with potassium permanganate solutions, although some untreated cuttings rooted also. The fact that there was an increase in the percentage of cuttings rooted when treated with potassium permanganate solution is in accordance with the results obtained by Curtis (1918) at Cornell University. He explained this phenomenon by stating that respiratory activity is increased by the potassium permanganate treatment by catalytically hastening oxidation.

Second experiment and results

For the purpose of checking the results of the first experiment, a second experiment was conducted in the same manner as the first. The results obtained are reported in table 5.

TABLE 5

Second experiment: the effect of potassium permanganate solutions on the root formation in lanzon cuttings. The cuttings were set April 7 to 9, 1924, and examined on June 28, 1924

TREATMENT	LENGTH OF SOAKING THE CUTTINGS	NO. OF CUTTINGS USED	NO. OF CUTTINGS ROOTED	PERCENTAGE
Check	—	60	2	3.33
0.5 per cent	12 hours	60	5	8.33
	24 hours	60	13	21.66
	48 hours	60	23	38.33
Check	—	60	22	36.66
1.0 per cent	12 hours	60	8	13.33
	24 hours	60	10	16.66
	48 hours	60	29	48.33
Check	—	60	26	43.33
1.5 per cent	12 hours	60	19	31.66
	24 hours	60	15	25.00
	48 hours	60	14	23.33
Check	—	60	10	16.66
2.0 per cent	12 hours	60	31	51.66
	24 hours	60	29	48.33
	48 hours	60	26	43.33
Check	—	60	5	8.33
3.0 per cent	12 hours	60	14	23.33
	24 hours	60	6	10.00
	48 hours	60	3	5.00

Checks. In check No. 1, 3.33 per cent of the cuttings formed roots; in check No. 2, 36.66 per cent; in check No. 3, 43.33 per cent; in check No. 4, 16.66 per cent; and in check No. 5, 8.33 per cent or 21.66 per cent on the average.

Results with 0.5 per cent solutions. The results show that for the 0.5 per cent treatment there were 8.33 per cent of the cuttings which formed roots after 12 hours' exposure or 13.33 per cent less than the check; with 24 hours, 21.66 per cent or just as high as the check; with 48 hours, 38.33 per cent or 16.67 per cent over the check.

Results with 1 per cent solutions. With a 1 per cent solution applied for 12 hours, 13.33 per cent of the cuttings formed roots or 8.33 per cent less than the check; with 24 hours, 16.66 per cent or 5 per cent less than the check; with 48 hours, 48.33 per cent rooted or 26.67 per cent over that of the check.

Results with 1.5 per cent solutions. With 1.5 per cent treatment for 12 hours there were 31.66 per cent of the cuttings formed roots or 10 per cent over that of the check; with 24 hours, 25 per cent or 3.34 per cent over the check; with 48 hours, 23.33 per cent or 1.64 per cent over the check.

Results with 2 per cent solutions. In the treatment with 2 per cent solution for 12 hours there were 51.66 per cent rooted or 30 per cent over the check; with 24 hours, 48.33 per cent or 21.67 per cent over the check.

Results with 3 per cent solutions. In treatment with 3 per cent solution for 12 hours there were 23.33 per cent or 1.67 per cent over the check; for 24 hours, 10 per cent or 11.66 per cent less than the check; for 48 hours, 5 per cent or 16.66 per cent less than the check.

In general, the results in this experiment resemble those from the first. Since this experiment was conducted under different weather conditions, some differences of results might be expected. The results of the second experiment agree with those of the first in almost every respect except in the comparison of the checks.

In the checks of the second experiment the average percentage of cuttings which formed roots is double that of the first. They gave 21.66 per cent or 11.66 per cent over that of the first experiment. The differences between the two may be due to several factors. In the first place the plant itself as a factor is very important. The conditions of the plants vary from time to time with periods of growth. The second experiment continued into the wet season when conditions are favorable for root formation. Hence it is to be expected that untreated cuttings might show more rooting than during the dry and cooler weather of December to March. Also, in the second experiment a number of cuttings, especially those that were treated with potassium permanganate solutions, were attacked by termites (*anay*) and red ants.

Third experiment and results

A third series of experiments along the same lines was begun on August 29, 1924. These experiments were repetitions of the first and second series but under different weather conditions, the first having been begun in the early part of the dry and cool season, the second in the driest and hottest part of the dry season and the third in the wet season. It is unfortunate that no reliable results were obtained from the third series of experiments because the cuttings were

attacked by termites and so many were destroyed that the results were entirely vitiated.

CONCLUSIONS

1. The lanzon can be propagated by cuttings. Over 50 per cent success was attained under optimum conditions provided.

2. Potassium permanganate solutions of correct concentration produce beneficial effects in root formation in cuttings. Marked beneficial results were noted from the treatment with 1.5 per cent to 2 per cent solution of potassium permanganate applied to cuttings for 12 to 24 hours before placing them in the sand.

Higher concentrations of the potassium permanganate solutions gave less marked results in stimulating root growth. Weaker solutions may be applied for longer and stronger solutions for shorter periods.

3. Cuttings may be transplanted directly to the nursery rows after they have made a well established root system in the beds.

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THE STATUS OF NUTRITION AMONG STUDENTS IN THE COLLEGE OF AGRICULTURE¹

F. O. SANTOS AND E. G. COLLADO
Department of Agricultural Chemistry

The promotion of the physical well-being of the student, as well as the direction of the purely intellectual development, is now a recognized function in progressive educational institutions. For years, the College of Agriculture has paid a physician to look after the health of its students; and the last two years a director has supervised their physical activities.

The watchfulness of a physician and the wisdom of a physical director, however, are not enough to insure sound physical development, as the body as well as the intellect is affected by the environment. Hence, the location of an institution, the kinds of recreation, the housing facilities and the food eaten are vital factors in a student's welfare. Whether or not the site of the College of Agriculture was selected with wisdom from the standpoint of physical and mental development, it is not our intention to consider, nevertheless, we may venture the statement that there are indications that the College is fortunate in its location.

At present the housing facilities are inadequate, but good dormitories are being built as fast as money for this purpose becomes available. For several years a Mess Hall where wholesome food can be obtained at reasonable prices has been in operation. As faculty members in charge of the Mess, it is our duty to study the nutrition of the students. For the status of nutrition of an individual is a good index of his physical well-being, because "under faulty nutrition the machinery of the body tends to break down in places and with frequency" (Campbell and Detwiller, 1925).

This report forms a part of an investigation on the status of nutrition among students in the College of Agriculture which we plan to carry out for several years.

METHOD

A perfectly accurate method for the determination of the status of nutrition of an individual is still wanting. Of the different methods now in use, the one devised by Clemens von Pirquet of Vienna (1922) appears just as accurate as the others and at the same time easy to operate. This system is based on the relation existing between the sitting height and the body weight; namely,

$$\sqrt[3]{\frac{\text{10 weight in gram}}{\text{sitting in height in cm}}} \times 100 = 100. \quad \text{This formula was devised after a large}$$

mass of anthropometric materials had been considered; it was then applied to more than 500,000 individuals. The résumé of the findings follows:

"The variations in the ratio for all age groups are similar. Children who have much fatty tissue reach the 100 mark, while the thin individuals remain

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below 90. In the case of adults, in addition to the fatty tissue we must also take account of the musculature, which raises the index about 5 points. Thin persons fall under 95, adipose persons over 105."

To make the formula easier to remember, Von Pirquet coined a word from the initials of the constituents: *P* stands for *pondus*, the body weight in grams. *Pe* recalls the fact that not the simple weight, but *pondus decies*, ten times the weight, will have to be taken. *Li* indicates that the weight must be converted into a linear function by taking the cube root of it. *Di* means division and *si*, sitting height. The word thus built is PELIDISI. The pelidisi, then, is an index of the nutritional state of an individual.

In the present investigation the pelidisi of 470 students were calculated. All the measurements were taken in a period of eight days, October 12 to 20, 1925. The students were classified into tribal groups and the data obtained are given in tables 1, 2, and 3. For the purpose of comparison the pelidisi of 224 boys and 202 girls in the colleges in Manila, taken in 1923, and of the regular boarders in the Mess Hall, are also included.

TABLE 1
Showing percentage of students having different nutritive indexes

GROUP	PELIDISI					
	80-84	85-89	90-94	95-99	100-104	90-99
	<i>per cent</i>	<i>per cent</i>	<i>per cent</i>	<i>per cent</i>	<i>per cent</i>	<i>per cent</i>
Tagalog.....	0.5	12.0	61.8	24.0	1.7	85.5
Visayan.....	—	7.9	41.7	45.6	4.8	86.3
Ilocano.....	—	7.0	52.1	40.9	—	93.0
Pangasinan.....	—	6.3	58.3	35.4	—	93.7
Pampangos.....	—	24.0	60.0	16.0	—	76.0
Bicol.....	—	—	64.7	29.4	5.9	94.1
Zambal.....	—	14.3	71.4	14.3	—	85.7
C. A.	0.2	9.8	54.7	33.2	2.1	87.9
Manila.. } Boys.....	—	29.0	54.0	15.6	1.4	69.6
} Girls.....	—	14.9	55.9	23.3	5.9	74.2
Mess Hall.....	—	8.8	55.9	32.4	2.9	88.3

TABLE 2
Showing actual number of students with certain nutritive indexes

GROUP	TOTAL NO.	PELIDISI					AVERAGE PELIDISI
		80-84	85-89	90-94	95-99	100-104	
Tagalog.....	175	1	21	108	42	3	93±0.17
Visayan.....	127	—	10	53	58	6	94±0.21
Ilocano.....	71	—	5	37	29	—	94±0.27
Pangasinan.....	48	—	3	28	17	—	93±0.28
Pampangos.....	25	—	6	15	4	—	92±0.43
Bicol.....	17	—	—	11	5	1	94±0.49
Zambal.....	7	—	1	5	1	—	92±0.68
C. A.	470	1	46	257	156	10	93±0.10
Manila.. } Boys.....	224	—	65	121	35	3	91±0.16
} Girls.....	202	—	30	113	47	12	93±0.16
Mess Hall.....	34	—	3	19	11	1	93±0.37

TABLE 3

Showing significance of differences in pelidisi

	DIFFERENCE	PROBABLE ERROR OF DIFFERENCE	
Visayan vs. C. A.	1	0.23	Significant
Ilocano vs. C. A.	1	0.29	Significant
Bicol vs. C. A.	1	0.50	Insignificant
C. A. vs. Pampango.	1	0.44	Insignificant
C. A. vs. Zambal.	1	0.69	Insignificant
Visayan vs. Tagalog.	1	0.27	Significant
Ilocano vs. Tagalog.	1	0.31	Significant
Ilocano vs. Pangasinan.	1	0.39	Insignificant
Bicol vs. Tagalog.	1	0.51	Insignificant
Tagalog vs. Pampango.	1	0.46	Insignificant
C. A. vs. Manila.	2	+0.19	Very significant

Table 1 shows that the majority of the College of Agriculture students have a pelidisi between 90-99; while the majority of the Manila students measured have a pelidisi of between 85-94. In other words, about 88 per cent of the College of Agriculture students have a pelidisi between 90-99 as against 70 per cent of the Manila students. This seems to indicate that the College of Agriculture students are better nourished than college students in Manila.

Taken group by group, we find that the majority of the Tagalogs, Visayans, Ilocanos, Pangasinanes, and Bicolanos fall in the 90-99 class, while the Pampangos may be classified with the Manila students. The Zambals may be put in either class. However, there are very few Pampangos, Bicolanos and Zambals among the students, so little weight can be given to the findings as regards these groups. The majority of the Manila college girls measured fall in the 90-99 class.

Table 2 shows that the average pelidisi of the College of Agriculture students is 93 ± 0.10 while the Manila boy students have 91 ± 0.16 . The average for each tribe was tabulated, also. It may be noted that the Tagalog with a pelidisi less than 85 is one of the poorest students in his studies in the College.

By calculating the probable error of the difference the significance of the variations was estimated (table 3). From these data, the following conclusions seem inevitable:

1. The College of Agriculture students are better nourished than the boys in the Manila colleges of the University of the Philippines, who were measured.
2. The Visayans and Ilocanos in the College of Agriculture are better nourished than the average student in this institution.
3. The average status of nutrition for no group in the College of Agriculture was poorer than the average for this College.

The fundamental causes of these differences in status of nutrition are difficult to explain. The following reasons are tentatively offered:

1. The well-being of an individual does not only depend on the food eaten, but also on his surroundings. Manila is a city situated at sea level on a delta, while the College of Agriculture is located on the foothills of Mount Maquiling. There is probably a difference in favor of this College in the purity of the air. There are more evening amusement attractions in Manila that tempt students to keep late hours than there are in Los Baños. Also, these and other diversions

cause the Manila student to waste time which he attempts to make up by studying very late at night, thus shortening sleeping hours. While on the College Campus, there are very few evening amusements, or day time diversions to consume students' study time. Also, the lights in the College are not on later than 11:00 p. m. Consequently, College of Agriculture students are compelled to spend a reasonable amount of time in bed.

2. Owing to a wrong popular conception that the work in the College of Agriculture is largely manual, the weaklings do not come.

3. Most of the Visayans in the College of Agriculture are athletes.

4. The Ilocanos eat more vegetables than the other groups.

5. The Tagalogs and Pampangos live near Laguna Province, so even those who are not very able-bodied, come to the College. While of those of other groups whose homes are farther away only the able-bodied come.

It will be interesting to find out whether a student develops physically during his stay in the College. Further investigation may throw light on this question.

This investigation has already affected the dietary habit of some of the students. One with a low pelidisi and who ate very little vegetables is now eating more and more of this essential food material.

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A CASE OF POLYEMBRYONY IN RICE¹

PEDRO A. RODRIGO
Of the Department of Agronomy

WITH ONE PLATE

Polyembryony in rice (*Oryza sativa* Linn.) has not been reported in the Philippines. The writer knows of only one case of this phenomenon in rice that has been recorded; namely, that reported by Komuro (1922) of Japan. The case reported by Komuro was a rice grain which produced two plumules upon germination. The case reported in this paper is similar to Komuro's, except that his grew to maturity.

The case of polyembryony here reported was accidentally discovered in August, 1924, in a lot of germinated rice seeds used in connection with some research work on the longevity of seeds stored under different conditions.

Description of the seed

The rice seed which was found with two plumules was, both in size and in shape, like any ordinary grain of Inintiw, the variety to which the seed in question belonged. The seed was no better developed, nor larger than an ordinary Inintiw grain. When the seed was discovered the plumules, which were needle-like in shape, were about two centimeters in length, one being 1.65 centimeters long and the other, 2.15 centimeters. They emerged at the basal end of the seed. There were also two distinct primary radicles, one of which was 4.65 centimeters in length and the other, 7.47 centimeters.

A photograph and two drawings of the seed with its plumules were taken and are presented in plate I. Figure 1 is the photograph of the seedling, figure 2 is its lateral view with the seed unhulled, and figure 3 is another lateral view with the seed partly hulled so as to show the origin of the plumules and the radicles. Figure 2 was made just after the discovery that the seedling was polyembryonic, and figures 1 and 3 were made one day later. The seedling is being kept in the Department of Plant Physiology in a well preserved condition for future cytological studies.

At first, the writer thought that these plumules arising from a single seed, might be a case either of "early tillering" or "polyembryony". Upon further examination of the seed, however, the first assumption was considered only a remote possibility. In the first place, although the plumules emerged side by side from the caryopsis, the origin is distinct and separate. That is, the plumules both originated from the seed; one did not originate from the other. If one of the shoots were a tiller, then it would have originated from the other shoot, as a tiller strictly speaking is only a branch of the mother plant. So far as the writer knows the first tiller of a rice plant, under favorable conditions, generally appears about one and one-half weeks after germination and usually at the axil

¹ Experiment Station contribution No. 348. Read before the Los Baños Biological Club June 25, 1925. Received for publication October 29, 1925.

of the second and third leaves, very seldom at the first. No case has been observed by the writer where the first tiller originated at the axil of the coleoptile,—a case that would be more advanced than the one which is reported here, as there was not any visible trace of coleoptile which wrapped the bases of the plumules together.

Evidence which supports the contention that the germinated seed under discussion is a case of polyembryony in rice is the presence of two distinct primary radicles, a case contrary to the general behavior of the rice seed, which is to produce only one primary radicle upon germination. In this particular case, each plumule has its own radicle, which emphatically shows that there were two distinct embryos in the seed. In this connection it may be worth while to mention some of the results obtained by Kuwada (1910) of Japan in his study of the cytology of *Oryza sativa*. He shows in one of his text-figures, what he called an "abnormal formation of two embryosac-mother-cells". The formation of two embryosac-mother-cells in a cell would show the possible occurrence of polyembryony in rice.

Occurrence of polyembryony in rice

In an attempt to find more rice seeds that produce two plumules upon germination, four liters each of varieties Inintiw and Tiniaong were germinated and examined. This amount would mean approximately 107,000 seeds for each variety. Out of the 107,000 Inintiw seeds germinated, not a single grain producing two plumules was found. In the Tiniaong, out of the 107,000 seeds examined, there was one grain which produced two plumules. This seed was similar to the one described in this study; it had two plumules and two distinct primary radicles.

While the search for more cases of polyembryony in rice was limited to four liters each of varieties, Inintiw and Tiniaong, the result shows that this phenomenon is very uncommon in rice, at least, with these two varieties. The present data show that there is about one polyembryonic rice seed for about every 214,000 seeds.

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ILLUSTRATION

PLATE I

Figure 1. Photograph of seedling.

Figure 2. Lateral view of seedling with seed unhulled.

Figure 3. Lateral view of seedling with seed partly hulled, showing origin of plumules and radicles.

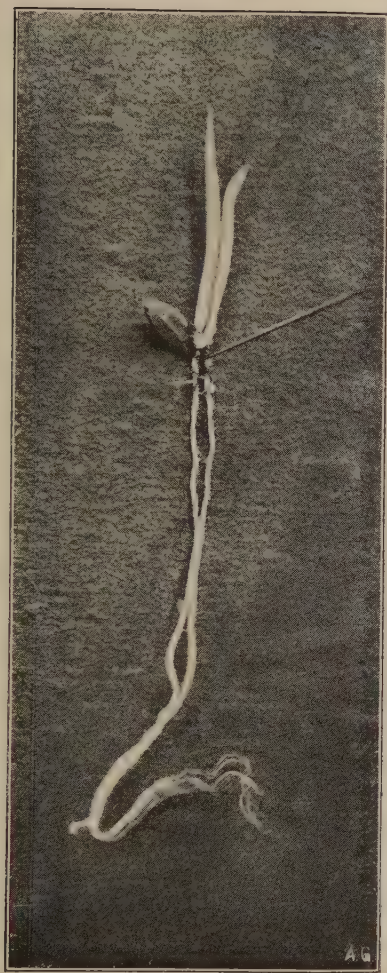


Fig. 1



Fig. 2



Fig. 3

A VIABILITY TEST FOR SOME TROPICAL SEEDS¹

PEDRO I. CRUZ

The data presented in this paper is a continuation of the work of Tolentino (1924). The procedure to be followed in using potassium hydroxide test for testing the viability of common farm seeds is indicated.

The primary objects of the experiment here reported were: (a) To determine if potassium hydroxide (KOH) solutions is a reliable test for the germinative power of some Philippine seeds, especially rice; (b) To find out which part of the seed effects the discoloration of the solutions; and (c) To determine the length of time and the concentration of the solution that will give the highest percentage of germination for a certain seed.

The investigation was carried out in the Department of Plant Physiology, College of Agriculture, University of the Philippines, from April to September, 1924.

MATERIALS AND METHODS

Stock solutions of potassium hydroxide of the following concentrations 0.025 *N*, 0.05 *N*, 0.1 *N*, 0.2 *N*, 0.3 *N*, 0.4 *N* were prepared from commercial caustic potash and rain water. The seeds used were obtained from the Department of Agronomy, College of Agriculture and from Montalban farmers.

In the operations, 25 kinds of seed and 600 small vials were used. Each kind, or variety of seed, was tested separately; that is, 700 seeds of one kind were counted, 100 of which were used for control. The vials were cleaned and arranged in six groups, 100 vials in a group. One seed was placed in each of the 600 vials. Then potassium hydroxide solutions were applied separately to every 100 seeds placed in the vials, using only one concentration for every 100 seeds. Enough solution to cover the seed was dropped with a medicine dropper or pipette in each vial. The time was recorded when the solution was applied. At thirty-minute intervals, for three hours, the number of seeds that discolored the solution was recorded and these seeds were separated from the others. (See table 2.)

All seeds after immersion in potassium hydroxide were placed in a sawdust seed box outside the laboratory to test their germinative power. Seeds treated with the same concentration were placed in one group; the seeds that discolored the solution were kept separate. The 100 seeds of each variety that were not immersed in any solution were germinated as control.

In order to determine which part of the seed is responsible for the discoloration of the solution, the seed coats of 25 seeds of each variety were removed and immersed in solutions (see table 3). The embryos of 25 viable (normal) and 25 non-viable seeds were dissected and immersed separately in the concentration where the percentage of germination coincided with the control.

¹ Thesis presented for graduation, 1925, with the degree of Bachelor of Agriculture from the College of Agriculture No. 221; Experiment Station contribution No. 349. Prepared in the Department of Plant Physiology under the direction of Professor D. A. Herbert.

EXPERIMENTAL RESULTS

The results are presented, tabulated as follows:

Table 1 represents the kind, variety, and age of the seeds used.

Table 2 shows the comparative viability test of the 25 kinds of seeds.

Table 3 shows the result of the color test with the respective normalities of the solution. This also indicates the normality best suited for the viability test for the various species.

DISCUSSION OF EXPERIMENTAL RESULTS

The experimental results presented are discussed briefly.

Potassium hydroxide solutions as a viability test for seeds

It was about twelve years ago when potassium hydroxide solutions were first used in determining the germinative faculty of seeds.

Table 1 shows the 25 varieties of seeds tested: These constitute the major and minor food crops of the Philippines. But by the potassium hydroxide test for viability, there were two classes of seeds classified according to color; namely, (a) seeds not naturally colored, that is, the external appearance of the seed coat is nearly colorless or white, such as soy bean, several varieties of rice, white patani, melon, cucumber, pea, kagyos, pepper, etc; (b) seeds, the seed coat of which is colored, as cowpea, rice (Bolilising), eggplant, water-melon, etc.

In table 2, it may be observed that the seeds not naturally colored (belonging to the first class) were found to respond to this test. The dead seeds belonging to the first class were found to discolor the solution within a few hours and the discoloration exhibited by these particular seeds indicated non-viability. This was confirmed by Lesage (1911) in his report "that the non-viable seeds were found to discolor the solution within a few hours". But, in most cases, the non-viable seeds discolored the solution in from one to two hours and the color imparted was similar to the color of the seeds.

Among the seeds investigated, 19 out of 25 varieties showed a positive result; this suggests that there is a wide range of testing the viability of the Philippine seeds by means of potassium hydroxide solutions. This test may be used with rice. There are, however, certain varieties where this test is not reliable, that is, there is a negative result with the second class of seed (naturally colored).

The percentage of germination of both control and test varies to some degree with most of the seeds; in some, as the soy bean, velvet bean, cucumber, rice (Murmuray), etc., there was a percentage germination of 95, 82, 89, 84 respectively.

Comparing the potassium hydroxide test with other germination tests in practice, it is hard to say which is the most satisfactory. Lesage (1911) has pointed out that "the potassium hydroxide test, although it indicated the correct percentage of seeds capable of germinating in some cases, failed with the others". The writer also found this true, as shown in table 2. But with some seeds, this method is more effective, easier and shorter than the one commonly used. For example, it took only three to four hours to finish the test of one or two varieties, while in the simple plate germinator described by Hillman, (1915), 2 to 14 days were necessary to finish a single variety. The latter case was what the writer observed in germinating the control seeds in the sawdust. Hartley (1905)

reported that in testing the germination of seed of corn in shallow boxes of moist sand with a damp cloth spread over, that 5 to 6 days were sufficient for germinating. Lesage reported that non-viable seeds discolored the solutions and the viable ones did not. But it was observed by the writer that not only the non-viable seeds produced color in the solutions, but also the viable seeds if naturally colored. Tolentino (1924) reported that the naturally colored seeds discolored the solutions.

Table 3 shows that the discoloration of the potassium hydroxide solution was caused by two classes of seeds; namely, seeds naturally colored—the seed coat of which is colored either brown, red or yellow; and seeds not naturally colored, in which some members are dead. There are three important parts of the seeds that are entirely responsible for the discoloration; (a) the discoloration exhibited by the sound naturally colored coats of seeds, as cowpea, rice (*Bolilising*), eggplant, etc.; (b) the discoloration accomplished by the cotyledons of the seeds, belonging to either the first or second class of seeds, as sword bean and radish; (c) dead seeds, in which all parts including embryo, cotyledons and seed coat may take part. There are instances where the embryo is the only part responsible for the discoloration, as rice (Iroy), cucumber, and melon. The last named indicates that the seeds found to discolor the solutions provided that they are not naturally colored were non-viable, although it does not hold true in the first case listed in table 2. The first was not enough indication for the non-viability of the seeds, because non-viability was proved by the result of the germination test. The latter suggests that unless the embryo was responsible for the discoloration, the seeds were viable. It was found that the color of the discolored potassium hydroxide solution was generally brown or yellow resembling the color of the non-viable seeds.

Even with the naked eye, it is possible to note a discoloration of the embryo upon dissecting the non-viable seed, also it is easily revealed by the alteration of the color of the potassium hydroxide solutions. This indicates the principle of this test.

Time and strength of solution required for testing

There is no definite rule as to the length of time and the strength of the solution required for testing any certain seed. Lesage reported that a few hours is sufficient to indicate the non-viable seeds and that the strength of the solution has to be varied for certain seeds.

Table 2 indicates the length of time and concentration of the potassium hydroxide solution required for testing viability of certain seeds. It was found that two to three hours was sufficient to indicate the non-viable seeds of the first class and the concentration varied according to the nature of the seeds. This test applies only to the unnaturally colored seeds, such as soy bean (*Glycine max* (Linn.) Merr.), velvet bean (*Mucuna deeringiana* (Bort) Merr.), pea (*Pisum sativum* Linn.), kagyos (*Cajanus cajan* (Linn.) Millsp.), jack bean (*Canavalia ensiformis* (Linn.) D C.), several varieties of rice (*Oryza sativa* Linn.), cucumber (*Cucumis sativus* Linn.), melon (*Cucumis melo* Linn.), pepper (*Capsicum annum* Linn. var. *grossum* Sendt.), and orange (*Citrus mitis* Blanco). All of the tests made for these seeds are discussed individually as to the length of time and strength of solutions required.

It is shown in table 2, that the viability of the seeds belonging to the family Leguminosæ may be tested by immersion in 0.1 *N* to 0.4 *N* solutions for not less than three hours. Practically all leguminous seeds have a thick hard seed coat, hence a low concentration of potassium hydroxide solutions can hardly penetrate it.

The soy bean (*Glycine max* (Linn.) Merr.) was tested by immersion in 0.1 *N* solution for two hours. The control test showed 95 per cent germination, while the solution test for two hours in 0.1 *N* showed that 4 seeds discolored the solution and 96 did not. The percentage of germination was zero for the ones that discolored and 95 for the ones that did not. Upon germinating one of the 96 seeds was destroyed.

In case of velvet bean (*Mucuna deeringiana* (Bort) Merr.) the right test was 0.3 *N* solution for three hours. In this length of time, 16 seeds discolored the solution and 84 did not. Germination test showed that 82 out of 84 seeds germinated, and none of the 16 seeds that discolored the solution germinated. This shows that the 0.3 *N* solution viability test for three hours was exactly the same as the percentage of germination obtained from the control.

For the pea (*Pisum sativum* Linn.), 0.05 *N* for at least three hours was the test. In this length of time, 36 seeds were found to discolor the solution, and 64 did not. But when subjected to germination test, all of the 64 seeds germinated and none of the 36. The percentage was 64, with 65 for the control.

For kagyos (*Cajanus cajan* (Linn.) Millsp.) 0.05 *N* solution and two and a half hours was the test. It was found that 52 seeds discolored the solution and 48 did not. Upon germination all the 48 seeds germinated but none of the 52. The percentage was 48 for both. This indicates that the test was dependable and exact.

The lima bean (*Phaseolus lunatus* Linn.) (white variety) and jack bean (*Canavalia ensiformis* (Linn.) D C.) were tested with 0.3 *N* and 0.4 *N* solutions, respectively, for two and a half hours. When these seeds were germinated, not a single one out of the 15 and 29 seeds that discolored the solution germinated, but all of the 85 and 71 seeds that did not discolor the solution grew. The percentages were 85 and 71 with 86 and 72 for the control. This shows that the test was approximately correct.

Seeds of different ages of ten varieties of rice (*Oryza sativa* Linn.), both lowland and upland, naturally colored and not naturally colored, glutinous and non-glutinous, were tested. The test was applicable to nine varieties: Iroy, Apostol Murmuray, Macan piña, Roxas, Conner, Dinagat na puti, Malagkit na dinalaga and Macan walang bulo, the exception was Bolilising. For the nine varieties, the test ranged from 0.2 *N* to 0.4 *N* solutions for three hours. Tolentino found that 0.2 *N* and 0.3 *N* solutions for three hours for Dinalaga and Kinandang kinapal, respectively, was approximately correct.

For Apostol and Murmuray, 0.2 *N* solution for three hours was a good test, as the control test showed 91 and 84 per cent, respectively. The test solution showed that 7 seeds of Apostol discolored the solution and 93 did not. None of the seeds that discolored the solution germinated, while 90 out of 93 seeds that did not discolor it, grew. With the Murmuray variety, 15 seeds discolored the solution and 85 did not. Germination test showed that one of the 15 seeds and

84 seeds out of 85 germinated. The percentages of germination for the control were 91 and 84 and 90 and 84 for the test, respectively.

For the family Cucurbitaceae, the cucumber (*Cucumis sativus* Linn.) and the melon (*Cucumis melo* Linn.) which have seeds of almost the same shape and appearance the test was with 0.2 *N* solution for three hours. Ten and three seeds discolored the solution while 90 and 97 did not, for cucumber and melon, respectively. In the germination test, none of the discolored seeds in either case germinated, but 89 and 95 seeds germinated out of 90 and 97 that had produced no discoloration. The percentages were 89 and 95 for the test, and 89 and 96 for both controls.

The tomato (*Lycopersicum esculentum* Mill.) and the pepper (*Capsicum annum* Linn. var. *grossum* Sendt.) of the family Solanaceae were tested in 0.025 *N* and 0.05 *N* solution. These seeds are rather small with thin seed coat, so that a low concentration is a sufficient test. The germination percentages were 84 and 80 with 81 and 80 for the control, showing a slight variation between the control and the test.

Seed of orange (*Citrus mitis* Blanco) was tested in 0.2 *N* solution for two and one half hours. The test indicated 96 per cent viability and upon germination 93 out of 96 seeds that did not discolor grew, whereas none for the seed that discolored the solution sprouted. The percentages were 93 and 94 for the control.

Table 2 shows that the potassium hydroxide solution was not a reliable viability test for the naturally colored seeds; namely, cowpea (*Vigna sinensis* (Linn.) Savi and Hassk.), rice (*Oryza sativa* Linn. variety (Bolilising), water-melon (*Citrullus vulgaris* Schrad.), radish (*Raphanus sativus* Linn.), and eggplant (*Solanum melongena* Linn.). It was observed that these seeds discolored the solution, although they were viable. In most cases when the seeds that discolored the solution were tried for germination they grew, as is shown in the case of cowpea, water-melon, radish, etc. In connection with this work, Tolentino proved that the naturally colored seeds are able to discolor the solution, and that they were able to germinate. Ninety out of 93 seeds of cowpea that discolored the solution germinated. With other naturally colored seeds, the same thing was true, except for rice, Malagkit na dinalaga, Conner, and Macan walang bulo. These three rice varieties were found to have unsatisfactory results in the germination test, but they discolored the solution the same as the others. In this case, not a single seed of Macan walang bulo grew for the control, but for Malagkit na dinalaga and Conner only 1 and 2 seeds germinated for the control, respectively. The cause of this was prolonged storage in the Seed Laboratory.

SUMMARY AND CONCLUSIONS

1. Potassium hydroxide solutions proved to be a satisfactory test reagent for testing the viability of some Philippine seeds; soy bean (*Glycine max* (Linn.) Merr.); velvet bean (*Mucuna deeringiana* (Bort) Merr.); pea (*Pisum sativum* Linn.); kagyo (*Cajanus cajan* (Linn.) Millsp.), lima bean (*Phaseolus lunatus* Linn.), jack bean (*Canavalia ensiformis* (Linn.) D. C.), several varieties of rice (*Oryza sativa* Linn.), namely, Iroy, Apostol, Murmuray, Macan piña, Conner, and Roxas; cucumber (*Cucumis sativus* Linn.), melon (*Cucumis melo* Linn.); tomato (*Lycopersicum esculentum* Mill.); pepper (*Capsicum annum* Linn. var. *grossum* Sendt.); and orange, (*Citrus mitis* Blanco).

2. The test does not apply to naturally colored seeds, such as cowpea (*Vigna sinensis* (Linn.) Savi and Hassk.), rice (*Oryza sativa* Linn.) variety Bolilising; radish (*Raphanus sativus* Linn.), water-melon (*Citrullus vulgaris* Schrad.), and eggplant (*Solanum melongena* Linn.).

3. The length of time and concentration required to test the viability varies with the different kinds of seeds as given below:

- a. Soy bean (*Glycine max* (Linn.) Merr.) 0.1 *N* solution for 2 hours.
- b. Velvet bean (*Mucuna deeringiana* (Bort) Merr.) 0.3 *N* solution for 3 hours.
- c. Pea (*Pisum sativum* Linn.) 0.05 *N* solution for 3 hours.
- d. Kagyos (*Cajanus cajan* (Linn.) Millsp.) 0.05 *N* solution for 2½ hours.
- e. Lima bean (white) (*Phaseolus lunatus* Linn.) 0.3 *N* solution for 2½ hours.
- f. Jack bean (*Canavalia ensiformis* (Linn.) D.C.) 0.4 *N* solution for 2 ½ hours.
- g. Rice (*Oryza sativa* Linn.) varieties Iroy, Apostol, Murmuray, Macan piña, Conner, Roxas, 0.2 *N* to 0.3 *N* solution for 3 hours.
- h. Cucumber (*Cucumis sativus* Linn.) and melon (*Cucumis melo* Linn.) 0.2 *N* and 0.3 *N* solutions for 3 hours, respectively.
- i. Tomato (*Lycopersicum esculentum* Mill.) 0.025 *N* solution for 3 hours.
- j. Pepper (*Capsicum annum* Linn. var. *grossum* Sendt.) 0.05 *N* solution for 3 hours.
- k. Orange (*Citrus mitis* Blanco) 0.02 *N* solution for 3 hours.

4. The embryo of the dead seed (not naturally colored) is the main cause for the discoloration of the solution.

5. The seed coat of the naturally colored seed is the part responsible for the discoloration of the solution and the potassium hydroxide method proved to be an unsatisfactory test for the viability of such seeds.

6. The color of the solution exhibited by non-viable seed is yellow or brown, while the embryo is brownish or dark brown to yellowish.

7. The strength of the solution affects the seeds, in some cases, killing them.

8. Leguminous seeds having thick, hard skins need to be tested with solutions of potassium hydroxide of rather high concentrations.

9. The time required for individual variety test is shorter than the common germination test.

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TABLE I
Showing the kind of seeds used and age

NO.	COMMON NAME	VARIETY NAME	SCIENTIFIC NAME	FAMILY NAME	AGE ^b
1	Soy bean		Glycine max (Linn.) Merr.	Leguminosæ	2 months
2	Velvet bean		Mucuna deeringiana (Bort) Merr.	Leguminosæ	4½ months
3	Pea ^a		Pisum sativum Linn.	Leguminosæ	1 year, 3 months
4	Cowpea		Vigna sinensis (Linn.) Savi & Hassk.	Leguminosæ	2 months
5	Kagyo	White variety	Cajanus cajan (Linn.) Millsp.	Leguminosæ	2 years, 5 months
6	Lima bean	White patani	Phaseolus lunatus Linn.	Leguminosæ	5 months
7	Jack bean		Canavalia ensiformis (Linn.)	Leguminosæ	6½ months
8	Rice	Iroy	Oryza sativa Linn.	Gramineæ	6½ months
9	Rice	Bollising	Oryza sativa Linn.	Gramineæ	7½ months
10	Rice	Apostol	Oryza sativa Linn.	Gramineæ	8 months
11	Rice	Murmuray	Oryza sativa Linn.	Gramineæ	8 months
12	Rice	Macan piña	Oryza sativa Linn.	Gramineæ	7 months
13	Rice	Conner	Oryza sativa Linn.	Gramineæ	4 years, 5 months
14	Rice	Roxas	Oryza sativa Linn.	Gramineæ	8 months
15	Rice	Malagkit na dinalaga	Oryza sativa Linn.	Gramineæ	10 months
16	Rice	Dinagat na puti	Oryza sativa Linn.	Gramineæ	4 years, 2 months
17	Rice	Macan walang bulo	Oryza sativa Linn.	Gramineæ	5 years, 6 months
18	Radish ^a	Puti	Raphanus sativus Linn.	Crucifereæ	8 months
19	Cucumber ^a	Bilog	Cucumis sativus Linn.	Cucurbitaceæ	1 year, 1½ months
20	Water-melon ^a		Citrullus vulgaris Schrad.	Cucurbitaceæ	6 months
21	Melon ^a		Cucumis melo Linn.	Cucurbitaceæ	4 months
22	Eggplant	White (long)	Solanum melongena Linn. Mill.	Solanaceæ	1 year, 3 months
23	Tomato ^a	Native	Lycopersicum esculentum Linn.	Solanaceæ	1 month
24	Pepper	Bilog	Capsicum annum Linn. var. grossum Sendt.	Solanaceæ	2 months
25	Orange ^a	Sungsong	Citrus mitis Blanco.	Rutaceæ	1 month

^a Not College seeds.

^b Approximate age.

TABLE 2
Germination test and observation of the number of seeds that discolored the potassium hydroxide solution

KIND OF SEED	CONTROL No. of seeds germinated	NORMALITY OF KOH SOLUTIONS	OBSERVATION OF THE NO. OF SEEDS THAT DISCOLORED THE KOH SOLUTION, 30-MINUTE INTERVAL						TOTAL NO. OF SEEDS THAT DISCOLORED THE KOH SOLUTION	TOTAL NO. OF SEEDS THAT DID NOT DISCOLOR THE KOH SOLUTION	NO. OF SEEDS GERMINATED AFTER SOAKING IN KOH SOLUTION	
			1st	2nd	3rd	4th	5th	6th			Seeds that discolored the solution	Seeds that did not dis- color the solution
Soybean	95 (95%)	0.025	0	0	0	0	1	1	2	98	0	96
		0.05	0	0	0	1	1	0	2	98	0	92
		0.1	0	1	3	0	0	0	4	96	0	95
		0.2	0	1	2	1	0	0	4	96	1	90
		0.3	0	1	4	1	1	0	7	93	0	93
Velvet bean	82 (82%)	0.4	1	4	0	0	1	0	6	94	0	86
		0.025	0	1	1	4	6	0	12	88	2	85
		0.05	0	1	2	2	1	0	6	94	1	89
		0.1	0	2	1	4	2	0	9	91	0	84
		0.2	0	1	3	1	2	1	8	92	0	80
Pea	65 (65%)	0.3	4	2	5	2	1	2	16	84	0	82
		0.4	5	4	2	1	0	0	12	88	0	83
		0.025	2	1	8	10	11	4	36	64	1	62
		0.05	1	5	6	14	10	0	36	64	0	64
		0.1	0	0	10	10	15	0	35	65	0	64
Kagyo	48 (48%)	0.2	0	14	10	18	10	2	56	56	0	56
		0.3	5	12	13	10	5	1	46	54	1	50
		0.4	8	18	14	19	1	0	60	40	2	39
		0.025	12	19	21	1	0	0	53	47	0	46
		0.05	8	20	12	11	1	0	52	48	0	48
Cowpea	96 (96%)	0.1	13	18	28	0	0	0	59	41	0	41
		0.2	11	25	15	2	0	0	53	47	1	45
		0.3	16	21	14	8	1	0	60	40	0	39
		0.4	21	19	11	10	1	0	61	39	0	35
		0.025	31	45	11	5	1	0	93	7	90	7
Lima bean	86 (86%)	0.05	35	28	20	10	2	2	97	3	92	3
		0.1	37	16	18	19	4	8	92	8	89	4
		0.2	38	35	9	11	5	2	100	0	91	0
		0.3	35	30	18	12	4	0	99	1	86	0
		0.4	40	20	15	16	9	0	100	0	82	0
Jack bean	72 (72%)	0.025	0	4	3	0	0	0	7	93	1	89
		0.05	1	2	8	0	0	0	11	89	0	88
		0.1	2	6	4	0	0	0	12	88	0	83
		0.2	3	8	0	1	1	0	13	87	0	85
		0.3	3	4	2	5	1	0	15	85	0	85
Jack bean	72 (72%)	0.4	4	8	3	2	0	1	18	82	0	82
		0.025	0	3	1	2	11	0	17	83	1	79
		0.05	1	1	4	2	10	0	18	81	0	80
		0.1	0	1	3	4	2	11	20	80	0	80
		0.2	5	2	8	4	0	0	19	81	0	79

Rice (Iroy)	78 (78%)	0.3 0.4	3 6	8 4	10 1	3 12	0 6	1 0	27 71	0 0	73 71
		0.025 0.05 0.1 0.2 0.3 0.4	0 0 0 0 0 0	0 0 0 0 0 0	2 1 0 0 4 2	8 4 0 3 2 2	0 3 5 2 5 4	0 4 3 9 4 1	10 8 12 11 16 9	2 0 1 0 0 0	88 82 76 79 84 76
Rice (Bollising)	89 (89%)	0.025 0.05 0.1 0.2 0.3 0.4	10 8 11 13 18 16	26 21 16 16 23 30	30 18 31 24 41 34	28 36 26 38 14 20	5 17 12 8 4 0	0 2 2 1 0 0	99 100 100 100 100 100	1 0 0 0 0 0	91 90 86 88 84 85
Rice (Apostol)	91 (91%)	0.025 0.05 0.1 0.2 0.3 0.4	0 0 0 0 0 0	0 0 0 0 0 1	0 0 0 0 0 0	0 0 0 0 0 2	0 0 2 2 4 1	0 0 1 5 3 5	0 0 3 7 7 9	100 100 97 93 93 91	0 0 1 0 0 2
Rice (Murmuray)	84 (84%)	0.025 0.05 0.1 0.2 0.3 0.4	0 0 0 0 0 0	0 0 0 0 1 0	0 0 2 0 0 2	1 0 6 5 3 0	0 1 0 8 9 10	0 4 1 2 2 4	1 5 13 15 21 16	99 95 87 85 79 84	0 1 2 3 3 1
Rice (Macan piña)	87 (87%)	0.025 0.05 0.1 0.2 0.3 0.4	0 0 0 0 0 0	0 0 0 0 0 2	0 1 0 4 3 4	0 0 2 2 4 0	4 2 5 3 2 1	1 3 1 2 4 1	5 6 8 9 13 8	95 94 92 91 87 92	0 0 0 0 0 0
Rice (Conner)	2 (2%)	0.025 0.05 0.1 0.2 0.3 0.4	0 2 1 0 8 4	20 18 14 21 24 11	24 25 21 18 31 35	19 20 34 38 28 26	21 30 21 12 8 19	5 1 6 9 0 2	89 96 4 4 2 97	11 4 4 2 1 3	0 1 3 1 0 2
Rice (Malagkit na dinalaga)	1 (1%)	0.025 0.05 0.1 0.2 0.3 0.4	2 1 4 3 2 12	11 16 12 19 14 34	24 21 19 26 34 36	21 31 32 28 32 17	18 23 30 9 16 1	11 1 2 13 0 0	87 92 99 98 100 100	13 8 1 2 0 0	0 0 0 0 0 0
Rice (Roxas)	86 (86%)	0.025 0.05 0.1 0.2 0.3 0.4	0 0 0 0 0 0	0 0 0 0 0 1	0 1 0 2 4 6	0 2 4 2 6 4	3 3 2 6 2 5	4 1 6 5 2 1	7 7 12 15 14 17	93 93 88 85 86 83	0 0 0 0 0 1
Rice (Dinagat na puti)	10 (10%)	0.025 0.05 0.1 0.2 0.3	0 1 0 2 1	0 8 6 11 7	16 19 17 13 21	19 16 28 18 11	21 14 19 24 18	22 21 18 23 21	78 79 88 91 79	22 21 12 9 21	0 0 0 0 0

walang bulo)		0.2 0.3 0.4	1 2 1	9 6 11	19 16 24	25 22 16	18 13	20 21 4	92 88 70	1 8 30	0 0 0	0 0 0
Cucumber (White)	89 (89%)	0.025 0.05 0.1 0.2 0.3 0.4	0 0 0 0 0 0	0 0 0 1 3 0	0 0 4 5 8	0 2 5 3 2 4	4 1 2 2 3 6	1 2 2 0 0 0	5 5 8 10 13 18	95 95 92 90 87 82	0 1 0 0 1 0	90 91 91 89 86 79
Watermelon	80 (80%)	0.025 0.05 0.1 0.2 0.3 0.4	5 8 11 21 20 21	20 24 45 52 40 29	28 38 40 27 9 41	30 21 4 0 21 8	7 7 0 0 9 1	0 0 0 0 0 0	90 98 100 100 99 100	10 2 0 0 1 0	67 80 82 80 69 79	9 2 0 0 1 0
Melon	96 (96%)	0.025 0.05 0.1 0.2 0.3 0.4	0 0 0 0 0 0	0 0 0 0 0 1	0 0 0 0 0 0	0 0 2 0 0 0	0 0 1 0 0 0	0 0 1 0 0 0	0 0 1 3 0 1	100 100 99 100 99	0 0 1 0 0 0	94 90 91 95 92 91
Eggplant	56 (56%)	0.025 0.05 0.1 0.2 0.3 0.4	14 11 13 12 14 17	22 23 11 23 32 34	33 14 22 34 13 33	11 25 21 12 21 12	10 22 21 11 12 0	0 1 1 0 0 0	90 96 95 92 90 96	10 4 5 8 8 4	49 45 53 48 40 41	5 1 2 3 4 1
Tomato	81 (81%)	0.025 0.05 0.1 0.2 0.3 0.4	0 0 0 0 0 2	0 0 2 0 5 0	0 1 1 4 0 8	0 0 3 2 0 0	11 2 2 2 9 1	4 1 5 2 2 0	15 3 8 13 16 11	85 97 91 87 84 89	4 0 1 2 1 0	80 96 91 86 84 81
Pepper (Bilog)	80 (80%)	0.025 0.05 0.1 0.2 0.3 0.4	0 2 4 3 2 1	0 1 3 6 3 0	1 3 4 4 8 2	4 10 1 3 11 11	8 2 3 5 0 1	10 0 5 0 1 0	23 18 20 21 25 15	77 82 80 79 75 85	1 0 0 1 0 0	76 80 78 70 74 84
Radish	75 (75%)	0.025 0.05 0.1 0.2 0.3 0.4	0 0 0 1 2 1	0 1 0 8 6 11	2 2 11 21 31 38	4 6 9 41 42 46	18 20 40 21 12 4	14 21 28 8 7 0	38 50 88 100 100 100	62 50 61 0 0 0	18 30 61 54 61 58	61 45 10 0 0 0
Orange (Sungsong)	94 (94%)	0.025 0.05 0.1 0.2 0.3 0.4	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 2 0 4	0 2 0 1 0 1	1 1 2 2 1 0	0 0 0 0 0 0	1 3 3 4 1 5	99 97 98 96 99 95	0 0 0 0 0 0	98 97 95 93 90 91

TABLE 3
Results of color test

KIND OF SEED	NORMALITY OF KOH SOLUTIONS	NATURAL COLOR OF SEED-COAT	COLOR OF KOH SOLUTIONS AFTER SEEDS ARE SOAKED SKIN NOT REMOVED ^a	COLOR OF KOH SOLUTIONS SKIN REMOVED ^a	COLOR OH KOH SOLUTIONS EMBRYO DISSECTED			
					Viable seed		Non-viable seed	
					Embryo	Other parts	Embryo	Other parts
1. Soybean.....	0.1	Waxy white	None	None	None	None	Dark yellow	None
2. Velvet bean.....	0.3	Waxy white	None	Light yellow	None	None	Yellow	None
3. Pea (Chicharo).....	0.05	Waxy white	None	None	None	None	Brownish	Brown
4. Cowpea.....	0.1	Brownish	Dark brown	None	None	Deep brown	Brownish	Brownish yellow
5. Karyos.....	0.05	Waxy white	None	Light yellow	None	None	Pale brown	Light yellow
6. Lima bean.....	0.3	Waxy white	None	Brown	None	None	Deep brown	Brown
7. Jack bean.....	0.4	Grayish	None	Reddish	None	Slight yellow	Dark yellow	Light brownish
8. Rice (Iroy).....	0.2	Whitish yellow	None	None	None	None	Brown	None
9. Rice (Bollising).....	0.2	Dark brown	Deep brownish yellow	None	None	Deep brownish yellow	Light brown	Deep brownish yellow
10. Rice (Apostol).....	0.2	Waxy white	None	None	None	None	Yellow	Yellow
11. Rice (Murmuray).....	0.2	Light yellow	None	None	None	None	Yellow	Dark yellow
12. Rice (Macan piña).....	0.3	Light yellow	None	None	None	None	Brown	None
13. Rice (Conner).....	0.3	Light brown	Slight color	None	None	Light color	Brownish	Light brown
14. Rice (Roxas).....	0.3	Yellowish brown	Yellowish	None	None	Yellowish	Yellow	Yellowish brown
15. Rice (Malagkit).....	0.2	White	None	None	None	None	Brown	None
16. Rice (Dinagat).....	0.05	Light yellow	None	None	None	None	Brown	None
17. Rice (Macan walang bulo).....	0.1	Light yellow	None	None	None	None	Brown	None
18. Cucumber.....	0.2	White	None	None	None	None	Brown	None
19. Water-melon.....	0.025	Brownish gray	Brown	None	None	None	Golden yellow	Yellowish
20. Melon.....	0.3	White	None	None	None	Deep brown	Dark brown	Yellowish brown
21. Eggplant.....	0.025	Brownish	Brown	None	None	None	Pale yellow	None
22. Radish.....	0.1	Brownish	Brownish yellow	None	None	Brownish	Dark yellow	Deep brown
23. Tomato.....	0.025	Grayish	Brown	Light yellow	None	Pale yellow	Dark yellow	Dark yellow
24. Orange.....	0.2	White	None	Light yellow	None	Light brown	Dark yellow	Deep brown
25. Pepper.....	0.05	White	None	Light yellow	None	Yellowish	Dark yellow	Dark yellowish
					None	None	Dark brown	None

^a Seeds used were all sound.

A NOTE ON LIMBERNECK¹

A. K. GOMEZ

Of the College of Veterinary Science

WITH ONE TEXT FIGURE

From time to time, poultry owners come to the College of Veterinary Science with the complaint that some one had poisoned their chickens. This suspicion on their part is so strong that, in some instances, it has caused them to take revenge on their neighbors in some form or another. In the majority of these cases, the writer determined the cause of death of the chickens to be limberneck, and in some cases an explanation of the pathogenesis of the disease had to be given in order to dissuade the poultry owners from their wrong and, we might say, dangerous suspicions. But to give such an explanation is not an easy matter, as limberneck is only a symptom of a disease whereby there is present a partial or complete loss of control of the neck muscles in the chickens. The term, "limberneck," does not convey a concrete idea of the disease and its common use is inaccurate. But until a more comprehensive study of the pathogenesis of this disease is made, no adequate substitution can be offered for the term "limberneck".

The cause for limberneck is varied. Digestive disturbances, intestinal parasites, meat poisoning, chemical intoxication, etc., have been reported to cause this condition. Feeding on maggots from decaying vegetable or animal matter is a frequent cause for this affection.

In the Philippines where chickens are allowed to run at large, and particularly in places where care is not taken in disposing of garbage, cases of limberneck are very common. Numerous cases of this disease in Los Baños and in the neighboring towns have come under the observation of the writer. In these cases, the most frequent cause was found to be feeding on maggots from decaying vegetable or animal matter. It is not unusual to observe in our barrio roads and fields the none too agreeable sight of dead animals left unburied. In their decomposition they breed immense numbers of maggots, and chickens are prone to partake of a hearty meal from these decaying carcasses.

These chickens may be found dead in their roosting places the following morning. Some may not die so quickly, but show symptoms of poisoning. Deaths in the flock may be registered for two or three days thereafter, depending upon the number which ate of the decaying material, then the disease will stop as suddenly as it made its appearance.

The symptoms shown by the sick birds are as follows: eyes closed; loss of control of the head and neck muscles; these are relaxed and soft on palpation;

¹ Experiment Station contribution No. 350. Received for publication, November 15, 1925.

inability to stand up; when forced to do so, the head touches the ground and the digits are flexed. There is no elevation of temperature and in some hypothermia may be present. Figure 1 shows the characteristic appearance of the affected birds.



Fig. 1.—A native hen affected with limberneck caused by eating maggots.

On autopsy the following lesions have been found: Crop filled with grains of "palay," corn, green leaves, etc. There are present dead maggots, sometimes many, sometimes only a few. The mucous membrane of the crop is reddened. A sweetish fetid odor is detected. The heart may be petechiated and in some cases there will be seen hemorrhagic extravasations in the endocardium of the left ventricle. The myocardium has a cooked appearance. The mesenteric arteries are engorged; the mucous membrane of the small intestines will be markedly congested or hemorrhagic throughout and its content is watery. The mucous membrane of the cloaca is also reddened. The gizzard may contain partially digested feed and maggots. The liver is enlarged and reddened. The spleen shows congestion and hyperplasia of the Malpighian corpuscles. The kidneys are swollen and congested and the bone marrow, markedly reddened.

The morbid anatomy is pathognomonic of an intestinal intoxication.

PUBLISHED CONTRIBUTIONS OF THE COLLEGE OF AGRICULTURE: III¹

CHARLES FULLER BAKER

Dean, College of Agriculture

The presentation of the following large list of additional contributions by the staff of the College of Agriculture of the University of the Philippines that have appeared since the second list of March, 1925, indicates continued great activity in necessary investigations relating to Philippine Agriculture, on the part of the staff of this College.

It will be noted that practically none of this work is confined to problems in pure science. But on the other hand nearly all of it relates to practical questions directly or indirectly affecting Filipino farmers. The prosecution of such work at the College of Agriculture has been absolutely necessary—essential to the building up of reasonable and applicable courses of instruction. In fact courses of instruction distinctly adapted to Philippine conditions and problems could be built up in no other way.

It is to be regretted that active agricultural experiment station work, such as is now highly developed in every progressive country, has never been organized on any permanent footing in the Philippines. This has left development along these lines to a large extent a matter of individual enterprise, sometimes with limited support available for it, and more often with none. Even under these circumstances, the output has been copious and of great value and it seems to me that under the circumstances the warmest congratulations are due to all who have been connected with it.

II: EXPERIMENT STATION CONTRIBUTIONS

The contributions are numbered serially as reported. For Nos. 1-199, see *THE PHILIPPINE AGRICULTURIST* XII. No. 7. December, 1923. For Nos. 200-287, see *THE PHILIPPINE AGRICULTURIST* XIII, No. 10. March, 1925.

- (288) PENDLETON, ROBERT L. 1925. Airplane control of insects, particularly of locusts in the Philippine Islands. *Sugar Central and Planters' News* 6: 186-193. *Fig. 1.*
- (289) See Circular No. 6.
- (290) See Circular No. 7.
- (291) DAVID, PEDRO A. 1925. A study of inheritance in tobacco crosses involving native and imported varieties. *The Philippine Agriculturist* 14: 3-35.
- (292) TEODORO, A. L. 1925. Plows and plowing: I. Plowing, a power consuming operation on the Philippine farm. *The Philippine Agriculturist* 14: 37-38.
- (293) CAPINPIN, JOSÉ M. 1925. A study of the Mendelian inheritance in natural hybrids of rosal (*Gardenia florida* L.). *The Philippine Agriculturist* 14: 39-43. *Pl. 1; fig. 1.*
- (294) PANGANIBAN, ELIAS H. 1925. Temperature as a factor in nitrogen changes in the soil. *Journal of the American Society of Agronomy* 17: 1-31. *Charts 1-4. Abstract in The Philippine Agriculturist* 14: 309-310, 1925. (Exper. Sta. contribution No. 316).
- (295) ALINCASTRE, CECILIO. 1925. A brief survey of the cane sugar industry in Louisiana and the Territory of Hawaii. *Sugar News* 6: 137-143. *Chart 1.*

¹ General contribution from the College of Agriculture, No. 162.

- (296) ADRIANO, FELIPE T. 1925. The proximate chemical analysis of Philippine foods and feeding stuffs. *The Philippine Agriculturist* **14**: 57-91.
- (297) MANUEL, CANUTO G. 1925. A study of the meat supply in the City of Manila. *The Philippine Agriculturist* **14**: 93-110. *Fig. 1*.
- (298) PAGLINAWAN, SERGIO B. 1925. A study of the flowering habits and flower characteristics of different varieties of sugar cane. *The Philippine Agriculturist* **14**: 111-123.
- (299) WELLES, COLIN G. 1925. Taxonomic studies on the genus *Cercospora* in the Philippine Islands. *American Journal of Botany* **12**: 195-218. *Pl. 11-20*.
- (300) TEODORO, A. L. 1925. Plows and plowing: II. A study of some typical Filipino native plows. *The Philippine Agriculturist* **14**: 135-142. *Pl. 1; fig. 2*.
- (301) LIMUACO, MAMERTO E. 1925. A study of soft cheese making. *The Philippine Agriculturist* **14**: 143-154.
- (302) RODRIGO, PEDRO A. 1925. Pollination and the flower of rice. *The Philippine Agriculturist* **14**: 155-172. *Pl. 2; fig. 1*.
- (303) URETA, ELIGIO C. 1925. The effect on soil phosphorus of rice culture. *The Philippine Agriculturist* **14**: 173-183.
- (304) ROLDAN, E. F. 1925. Notes on soft rot of radish. *The Philippine Agriculturist* **14**: 185-188. *Pl. 1*.
- (305) OCFEMIA, G. O., AND J. A. AGATI. 1925. The cause of the anthracnose of avocado, mango, and upo in the Philippine Islands. *The Philippine Agriculturist* **14**: 199-216. *Pl. 1-3*.
- (306) VILLEGAS, VALENTE. 1925. Horse breeding in the Philippines. *The Philippine Agriculturist* **14**: 217-234. *Pl. 1; fig. 1-4*. (Circular No. 8.)
- (307) PANGANIBAN, ELIAS H. 1925. A preliminary study of the effect of pressure upon the nitrogen changes in the soil. *The Philippine Agriculturist* **14**: 235-242.
- (308) SANTOS, F. O., AND E. G. COLLADO. 1925. Vitamin B in tikitiki extract prepared by the Philippine Bureau of Science. *The Philippine Agriculturist* **14**: 243-245. *Chart 1*.
- (309) QUISUMBING, EDUARDO. 1925. Stony layer in seeds of Gymnosperms. *Botanical Gazette* **79**: 121-193. *Pl. 1-9; fig. 1-88*.
- (310) PAÑGANIBAN, ELIAS H. 1925. Soil acidity tests. *Sugar Central and Planters' News* **6**: 398-400.
- (311) GONZALES, SALUSTIANO S. 1925. The sweet potato weevil (*Cylas formicarius*, Fabr.). *The Philippine Agriculturist* **14**: 257-281. *Pl. 1-3*.
- (312) FRONDA, F. M. 1925. The turkey industry of Añgono, Rizal. *The Philippine Agriculturist* **14**: 283-288. *Fig. 1-3*.
- (313) OCFEMIA, G. O. 1925. The occurrence of the white rust of crucifers and its associated downy mildew in the Philippines. *The Philippine Agriculturist* **14**: 289-296. *Pl. 1-2*.
- (314) TEODORO, A. L. 1925. Plows and Plowing: III. Draft tests on four makes of single-animal walking plows. *The Philippine Agriculturist* **14**: 297-301. *Fig. 1-2*.
- (315) SIBAL, ENRIQUE M. 1925. Grain supplements for raising water buffalo calves. *The Philippine Agriculturist* **14**: 303-307.
- (316) *Abstract. See No. 294.*
- (317) PENDLETON, ROBERT L. 1925. The drainage of cane lands in the Philippines. *Sugar Central and Planters' News* **6**: No. 10: 621-631. *Fig. 1-3; 6. No. 11: 720-728. Fig. 1*.
- (318) OCFEMIA, G. O. 1925. The Phytophthora disease of eggplant in the Philippine Islands. *The Philippine Agriculturist* **14**: 317-328. *Pl. 1-2; Fig. 1-4*.
- (319) UNITE, JUAN O. 1925. A study of the asexual inheritance of stooling habit of sugar cane seedlings. *The Philippine Agriculturist* **14**: 329-347. *Pl. 1*.
- (320) ADRIANO, FELIPE T., AND ELIGIO J. TAVANLAR. 1925. The calcium oxide content of some Philippine foods. *The Philippine Agriculturist* **14**: 347-357.
- (321) CABAILO, BENJAMIN C. 1925. Weeds in the rice fields and their effect on the yield of grain. *The Philippine Agriculturist* **14**: 359-371. *Fig. 1-3*.
- (322) CAVILLERO, PLACIDO L. 1925. Studies on the mineral requirements of swine: I. The effect of common salt and charcoal sodium sulfate and calcium phosphate on the growth of pigs. *The Philippine Agriculturist* **14**: 373-378.

- (323) REYES, TEODORICO P. 1925. A study of sex change in papaya and of correlation between sex and certain morphological characters of seedlings. *The Philippine Agriculturist* **14**: 391-412. *Pl. 1-3*.
- (324) GOMEZ, A. K. An outbreak of fowl cholera. *The Philippine Agriculturist* **14**: 413-420.
- (325) KALAW, MOISES, AND FRANCISCO M. SACAY. 1925. Some alleged Philippine poison plants. *The Philippine Agriculturist* **14**: 421-427.
- (326) GOMEZ, ELISEO T. Leaf blight of gabi. *The Philippine Agriculturist* **14**: 429-440. *Pl. 1; fig. 1-2*.
- (327) FRONDA, F. M. Duck-like posture among hens. *The Philippine Agriculturist* **14**: 441-444. *Fig. 1*.
- (328) PENDLETON, ROBERT L. 1925. Lines of investigation that the Philippine Sugar Association could conduct without an "Experiment Station". *Sugar Central and Planters' News* **6**: No. 12: 767-775.
- (329) BAKER, C. F. 1925. Remarks on certain Indo-Malayan *Fulgora* with special reference to Philippine species. *The Philippine Journal of Science* **28**: 343-364. *Pl. 1-10*.
- (330) QUISUMBING, EDUARDO, AND INOCENCIO, ELAYDA. 1926. A brief survey of conditions affecting agriculture in the Bicol region. *The Philippine Agriculturist* **14**: 437-471. *Fig. 1*.
- (331) SANTOS, F. O., AND E. G. COLLADO, 1926. The nutritive value of Philippine cereals: I. The vitamin B content of glutinous rice, dead rice, and adlay. *The Philippine Agriculturist* **14**: 473-477. *Chart 1*.
- (332) GONZALEZ, B. M., AND J. P. ESGUERRA. 1926. Fences for farm animals. *The Philippine Agriculturist* **14**: 479-490. *Fig. 1-8* (Circular No. 9).
- (333) MALABANAN, DEOGRACIAS B. 1926. Anthracnose of pepper. *The Philippine Agriculturist* **14**: 491-501. *Fig. 1-2*.
- (334) QUISUMBING, EDUARDO. 1925. Stony layer in seeds of Gymnosperms. *The University of Chicago Abstracts of Theses. Science Series* **1**: 414-417.
- (335) SULIT, VICTOR. 1926. Studies on toxicity of copra meal: I. *The Philippine Agriculturist* **14**: 511-522. *Charts 1-3*.
- (336) GOMEZ, A. K. 1926. Intensity and distribution of infectious diseases of animals in the Philippines. *The Philippine Agriculturist* **14**: 523-537.
- (337) MERCADO, TORIBIO, 1926. Sugar Cane breeding in the College of Agriculture: IV. Training Sugar cane plants for convenient pollination work. *The Philippine Agriculturist* **14**: 539-540. *Pl. 1*.
- (338) VILLEGAS, VALENTE. 1926. A study of the frequency of calving of cows, under Philippine conditions. *The Philippine Agriculturist* **14**: 541-547.
- (339) SANTOS, F. O. 1926. Need of funds for research. *The Philippine Agriculturist* **14**: 549-551.
- (340) HERNANDEZ, BASILIO. 1926. Germination of rice seeds: The effect of soaking in water and delayed sowing on the rate of percentage and uniformity of germination. *The Philippine Agriculturist* **14**: 553-556.
- (341) GAERLAN, SIXTO A. 1926. Comparative amounts of gases carbon dioxide, oxygen, and nitrogen found in the body of certain plants. *The Philippine Agriculturist* **14**: 557-567.
- (342) VILLANUEVA, AURELIANO J. 1926. Tannin plants of Mount Maquiling region. *The Philippine Agriculturist* **14**: 569-579.
- (343) BAKER, CHARLES FULLER. 1926. Third addition to Philippine and Malayan technical bibliography. *The Philippine Agriculturist* **14**: 589-593.
- (344) SULIT, VICTOR. 1926. Studies on toxicity of copra meal: II. *The Philippine Agriculturist* **14**: 595-607. *Charts 1-9*.
- (345) VILLEGAS, VALENTE, AND DANIEL B. PEÑA. 1926. Dairy management of native cows. *The Philippine Agriculturist* **14**: 609-612.
- (346) POLO, DIONISIO C. 1926. Propagation of the lanzon by marcottage and by cuttings. *The Philippine Agriculturist* **14**: 613-624.
- (347) SANTOS, F. O., AND E. G. COLLADO. 1926. The status of nutrition among students in the College of Agriculture. *The Philippine Agriculturist* **14**: 625-628.
- (348) RODRIGO, PEDRO A. 1926. A case of Polyembryony in rice. *The Philippine Agriculturist* **14**: 629-630. *Pl. 1*.

- (349) CRUZ, PEDRO I. 1926. A viability test for some tropical seeds. *The Philippine Agriculturist* 14: 631-641.
- (350) GOMEZ, A. K. 1926. A note on limberneck. *The Philippine Agriculturist* 14: 643-644. *Fig. 1.*
- (351) TEODORO, A. L. 1925. A preliminary study of the transverse strength of structural bamboo. *Agricultural Engineering* 2: 266-267. *Fig. 1-2.*
- (352) GAMBOA, FERMIN J. 1925. A summary of diseases and pests on canes. *Proceedings of the Third Annual Convention of the Philippine Sugar Association.* 1926: 40.
- (353) UICHANCO, LEOPOLDO B. 1925. A preliminary report on insects affecting sugar cane in the Philippines. *Proceedings of the Third Annual Convention of the Philippine Sugar Association.* 1926: 37-40.
- (354) OCFEMIA, G. O. 1925. Some of the minor and major diseases of sugar cane in the Philippine Islands. *Proceedings of the Third Annual Convention of the Philippine Sugar Association.* 1926: 33-37.

III: GENERAL CONTRIBUTIONS

The contributions are numbered serially as reported. For Nos. 1-104 *see THE PHILIPPINE AGRICULTURIST* XII. No. 7. December, 1923. For Nos. 105-141 *see THE PHILIPPINE AGRICULTURIST* XIII. No. 10, March, 1925.

- (142) YULE, EMMA SAREPTA. 1925. Progress among the Pagan Filipinos. *Inter-Ocean (Java)* 6: 22-26. *Fig. 1-9.*
- (143) BAKER, CHARLES FULLER. 1925. If—(Editorial). *The Philippine Agriculturist* 14: 1.
- (144) UICHANCO, L. B. 1925. A neglected phase of insect control work in the Philippines. (Editorial). *The Philippine Agriculturist* 14: 55-56.
- (145) GONZALEZ, B. M. 1925. Our beef supply. (Editorial.) *The Philippine Agriculturist* 14: 131-134.
- (146) GONZALEZ, B. M. 1925. Note: A recent trip to Darwin, Australia. *The Philippine Agriculturist* 14: 247-249.
- (147) VIBAR, TORIBIO. 1919. Organizing our available food forces for good production. *The Citizen*, October.
- (148) VIBAR, TORIBIO. 1920. An Insular Board of Agriculture should be organized in the Philippines. *The Citizen*, July 20.
- (149) VIBAR, TORIBIO. 1921. What is wrong with our present system of agricultural education? *The Citizen*, May 6.
- (150) VIBAR, TORIBIO. 1921. An agricultural factor of unlimited possibilities. *The Citizen*, May 21.
- (151) VIBAR, TORIBIO. 1921. Type of students from the College of Agriculture who have been highly successful farmers. *The Citizen*, May 28.
- (152) RODRIGO, PEDRO A. 1922. An agricultural course should be given in the high school. *Philippines Free Press*, August 19.
- (153) RODRIGO, PEDRO A. 1925. Agmulatang ti pagay a biit. (Let us plant early maturing varieties of rice.) *Ti Bagnos*, May.
- (154) YULE, EMMA SAREPTA. 1925. Down the rapids: Week end trip to Pagsanhan Gorge and Falls. *Japan* 14: 14-16. *Fig. 1-5.*
- (155) YULE, EMMA SAREPTA. 1925. Oriental daughters of the soil. *Inter-Ocean (Java)* 6: 416-422. *Fig. 1-9.*
- (156) VIBAR, TORIBIO. 1925. Urbanizing rural life. (Editorial.) *The Philippine Agriculturist* 14: 387-389.
- (157) YULE, EMMA SAREPTA. 1925. The English language in the Philippines. *American Speech* 2: 111-120.
- (158) BAKER, CHARLES FULLER. 1925. Professor Evett D. Hester: An appreciation. *The Philippine Agriculturist* 14: 125-126.
- (159) BAKER, CHARLES FULLER. 1926. The world of Science. *The Philippine Agriculturist* 14:
- (160) VIBAR, TORIBIO. 1926. The Village School; A powerful potential factor in rural improvement. *The Philippine Agriculturist* 14: 585-587.

- (161) BAKER, CHARLES FULLER. 1926. Professor J. E. Higgins: An appreciation. *The Philippine Agriculturist* **14**: 651.
- (162) BAKER, CHARLES FULLER. 1926. Published contributions of College of Agriculture: III. *The Philippine Agriculturist* **14**: 645-649.
- (163) PENDLETON, ROBERT L. 1926. Note: A review, *the Philippine Agriculturist*, **14**: 651.
- (164) COLLEGE OF AGRICULTURE. 1925. Handbook for the students of the Colleges of Agriculture and Veterinary Science and School of Forestry, University of the Philippines. 39 p. (Mimeographed.)

IV. CIRCULARS

The circulars are numbered serially as reported. For Nos. 1-5, see **THE PHILIPPINE AGRICULTURIST XIV. No. 10. March, 1925.**

- No. 6. GONZALEZ, B. M., AND TALEON, A. T. (Collected and compiled by) 1925. Conversion tables for common Philippine weights and measures including metric and English equivalents. (Multigraphed) (Experiment Station contribution No. 289).
- No. 7. MENDIOLA, NEMESIO B. 1925. How to produce new varieties of Gumamela (*Hibiscus*). (Mimeographed.) Experiment Station contribution No. 290.
- No. 8. VILLEGAS, VALENTE. 1925. Horse breeding in the Philippines. (See Experiment Station contribution No. 306.)
- No. 9. GONZALEZ, B. M., AND ESGUERRA, J. P. 1925. Fences for farm animals. (See Experiment Station contribution No. 332.)

NOTE: A REVIEW

Bamboo is an important structural material in the Philippines, and as such a greater knowledge of its properties would be of value, even though it is a material which is not very durable, and hence is not usually employed in a manner to use its properties most effectively. Professor Teodoro¹, of the Department of Rural Engineering of this College, appreciating the desirability of more exact information about the properties of bamboos, has described and illustrated in his paper a device used for testing the transverse strength of bamboos, that is, the weight which can be carried at the central point of a pole if the ends only be supported. He also studied the amount of bending of the pole resulting from various weights.

There is a popular belief that bamboos cut at certain seasons of the year are stronger than those cut at others; data in this paper seem to support this. Of the two varieties tested, the thorny bamboo proved to be stronger than the thornless, again supporting the popular idea. Attention is also called to the differences which may result in strength from diverse methods of curing, such as in the sun as compared with in the shade. Mention is made of the large number of interfering factors in such a study, such as variability in size, weight, thickness, and age of the poles when cut, as well as the number and length of internodes, and effects of disease. These factors could not be considered in the present study, and so the data obtained are only general in their indications.

It is unfortunate that in drawing the graphs the difficulties of reproduction were not appreciated. Consequently the graphs do not express the facts as clearly as might be wished.

ROBERT L. PENDLETON
Of the Department of Agronomy.

¹TEODORO, A. L. A preliminary study of the transverse strength of structural bamboo. *Agricultural Engineering* 6: 266-267. 1925.

PROFESSOR J. E. HIGGINS: AN APPRECIATION

Early in December, the College of Agriculture suffered another serious loss in the leaving of Professor and Mrs. Higgins. Professor Higgins is the last of the older men on the teaching staff of the College. He was one of a very small number of Americans who have devoted their lives to the broader fields of tropical agriculture and his long experience and wide knowledge of tropical conditions has been of no little service here in the Philippines. The immediate cause of his leaving at this time was the failing health of his wife, and the entire College staff joins in hoping for her early recovery. It will be impossible to replace Professor Higgins with any of the older and experienced men at the salary that was paid him. The younger men must now carry on the good work.

Professor Higgins was given a rousing "despedida" at the Y. M. C. A. hall in the evening of December 17, 1925. A number of members of the faculty

went to Manila to bid him and Mrs. Higgins good-by at the pier. We will always remember them because of the uniform kindness and good fellowship that characterized their relations with the staff. Kindly and well-meaning Christian people of the type of Professor and Mrs. Higgins are an ornament to any college staff and their influence is greatly to the benefit of all. We shall miss them. The best wishes of the whole community went with them.

CHARLES FULLER BAKER
Dean, College of Agriculture.

EXCHANGE NOTES

The *co-operative* organization of the entire farmers' business—at the producing end, in the transport of produce and its sale in the market—is treated as an essential condition of agricultural prosperity. Farmers must be so organized in their business that they, and not a horde of superfluous middlemen, will profit by the increased production resulting from the application of science to their industry. Unless the primary producers are properly organized, they simply won't take advantage of the educational and other assistance offered to them by the Government. This work, no matter how efficient, is then robbed of half its fruitfulness—and, incidentally, a large part of the money with which it is financed by the general taxpayer is wasted. The other reason for beginning with the organization of co-operation is not so obvious. Experience shows that, until farmers have learned to come together in the business of their lives, and have found it to be for their mutual advantage to do so, they cannot be induced to combine for the higher purposes of intellectual and social advancement. The co-operative system brings order out of chaos in the business of the rural community; the co-operative spirit humanizes its life. It must, therefore, be borne in mind that, in working out our formula, *Better Business* will be the foundation of *Better Farming* for one reason and of *Better Living* for another.

—*Journal of the Department of Agriculture* (Union of South Africa).

Goats are very largely bred in Jamaica, and we do not know of any more useful animals when they are kept in their proper place, and that is not running about roadsides, or trespassing on other people's land.

Not only is goat mutton the favorite flesh meat amongst the poor people, but it is also used by all classes, and sells at the same price as good beef. The little milk that the ordinary Nanny Goat gives is most useful for young children, * * *.

Then goats are exceedingly useful for their skins, which fetch a good price. Jamaica exports £13,746 of goat skins and they are quoted second highest in the markets. In some parts some large flocks of goats are (or used to be) kept on the poorer lands, and where there are sugar estates. Thus these are four good commercial qualities about goats. First the meat, second the milk, third the skin, fourth the manure. There is still another—their prolificacy—a flock increases very quickly.

On account of these qualities, lots of people see that there is money in goats, and they think also that because they see them running about roadsides or in the streets of towns, or tied about in the bush picking up a precarious living, that they are very hardy animals and not subject to disease at all. They are hardy certainly if they get the chance,—but it is because they are considered proof against disease that often the most ordinary treatment considered necessary for other stock is not given to them.

On a large scale goat breeding to be successful must be conducted on the same lines as cattle breeding, with subdivided pastures and proper paddocks and shelter, the different sexes kept apart, and so on.

—*The Journal of the Jamaica Agricultural Society.*

The effect of manures must also be considered. Farmers do not realize sufficiently that the amount of water required to produce a crop is greatly affected by the plant-food substances available. Other factors being normal, maximum crop yields can be obtained only if a sufficiency of every one of the various plant-food substances is present in available form, and provided the relative quantities in which they are present are satisfactory. From this it follows that a crop cannot make the best use of the water supply available to it unless its food supply is in every way satisfactory.

Experiments in America with maize show that when poor soil was manured it required 56 per cent. less water to produce a given crop yield than when unmanured. Manuring soil to ensure an adequate water supply for the crop is therefore a potent means of economizing water supply.

—*Journal of the Department of Agriculture (Union of South Africa).*

Guava, Onion, and Orange Salad.—This is a most refreshing and unusual combination. Take out your orange pulp as you would to eat, with a spoon, keeping the sections as whole as may be. Allow about 2 slices mild Spanish onion to each 1 orange, and as much guava pulp, clear as you have orange. You may of course use avocado, chopped, instead of guava, and mangoes instead of either; but unless you use the onion and orange you won't believe how well they go together. Use plenty of French dressing in serving.

—*The Journal of the Jamaica Agricultural Society*
Reprinted from *Florida Grower* (U. S. A.)

COLLEGE AND ALUMNI NOTES

The faculty with members of the agronomy staff as committee on arrangements gave a farewell banquet in honor of Professor and Mrs. Higgins in the evening of December 17, 1925, in the "Y" hall. Under the skillfull artistic hands of Mr. Dawis the room had been transformed with palms and flowers into a beautiful tropical banquet hall. Doctor Vibar, as toastmaster, introduced Dean Baker and Doctor Mendiola of the Agronomy Department who spoke of

the highly valuable services Professor Higgins had given to the cause of agriculture, especially to pomology in his years with the College, and paid high tribute to his courtesy and kindness in his relation with colleagues and students. Dean San Agustin of College of Veterinary Science who was scheduled to speak was unable to be present; his remarks were read by Dr. Zacarias de Jesus. Professor Higgins in response spoke on the policy that he had adopted as Head of the Department and paid a beautiful tribute to the aid and inspiration Mrs. Higgins had been in his work. Music for the occasion was furnished by the College Orchestra.

Dr. Georgiana Sweet, parasitologist of long experience, from the University of Melbourne was a College visitor, January 10. Doctor Sweet has a reputation as an authority in her chosen work. She is at present particularly interested in the life history of *Lyperosia exigua*. Our only regret is that this, our first woman doctor of Veterinary Science to visit our Colleges, could not prolong her visit beyond a day.

At the seventeenth meeting of the Los Baños Biological Club on December 16, the following papers were read and discussed:

"Bacterial wilt of Cosmos" by Mr. E. M. Roldan.

"Sugar cane breeding in the College of Agriculture: IV. Training sugar cane plants for convenient pollination work" by Dr. N. B. Mediola and Mr. T. Mercado. (Paper read by Doctor Mendiola.)

"Soil surveys in Negros and Mindoro" by Dr. Robert T. Pendleton.

At the eighteenth meeting, the following:

1. "Anthracnose of Guava." By Mr. J. A. Agati.

2. "Selection of Mosaic free cuttings of Sugar cane." By Messrs. J. O. Unite and J. M. Capinpin (Paper read by Mr. Capinpin).

3. "On the nature, distribution and significance of the hookworm infestation in the Philippines." By Doctors M. A. Tubangui and S. A. Francisco (Paper read by Doctor Francisco).

A "Handbook for the students of the Colleges of Agriculture and Veterinary Science and School of Forestry, University of the Philippines" was given to these students as a Christmas greeting at close of session for holiday recess. The committee responsible for the preparation of this excellent book was Prof. Mariano C. Lopez, Prof. T. F. O'Leary, Mr. Archie B. Nourse, all of the College of Agriculture, and Mr. A. W. Adolfo, Secretary of the "Y". The table of contents will give an idea of the scope of the book and its usefulness

GREETINGS:

From Hon. Eugene E. Gilmore, Vice Governor General and Chairman, Board of Regents.

From Hon. Rafael Palma, President, University of the Philippines.

From Dean C. F. Baker.

From Dean Gregorio San Agustin.

Relation of the Students to College.

Relation to Fellow Students.

- Social Relations and Recreation.
- Attitude toward Women.
- Relation to Citizenship.
- Relation to the Church.
- Relation to the Y. M. C. A.
- Thrift and Financial Obligations.
- "Sign Posts".
- Advice by Marcus Aurelius.
- A Definition of a Gentleman.
- Self Deception Through Crooked Thinking.
- Your Official Responsibilities.

The book is a most attractive piece of mimeograph work. On each page is an artistic conventional decoration. A personal touch was added by the following note slipped inside each book:

TO THE STUDENTS OF THE COLLEGE OF AGRICULTURE:

GREETINGS:

This little pamphlet is offered to you as a Christmas gift of your College. Humble and unostentatious as it is, I honestly feel that no better offering could be made. The beautiful thoughts therein expressed are more precious than the most priceless material things.

I would suggest that you read it not once, twice or three times but a hundred times, following as close you may the teachings that this little pamphlet imparts.

C. F. BAKER,
Dean.

An article on "The Coffee Industry in the Philippines: Its Decline and Partial Recovery" by Mr. Pedro David, instructor in agronomy department, appears in the January number of *The American Chamber of Commerce Journal*.

At the Young Women's Student Conference held in Baguio, December 26 to 30, 1911, the College of Agriculture was unofficially represented by Miss Margaret Wilson of the Department of English. Miss Wilson gave a series of talks on the women of China, yesterday and today, under the four topics: Social, Educational, Industrial, and Religious.

Professor E. D. Hester, formerly head of department of economics and registrar of college is now in the Latin American Division of Bureau of Foreign and Domestic Commerce, Department of Commerce, Washington, D.C. Professor Hester is also studying with Master's degree in view in Georgetown University, School of Foreign Commerce.

Mr. O'Leary of Department of English made the southern islands trip during holiday recess. He reports the trip well worth while, both for pleasure and knowledge gained of Islands.

A large map of Negros Island showing the sugar cane industry of the two provinces was recently presented to the College Library by Dr. Sam. F. Trelease.

The Christmas Eve party given by the faculty members and "Y" for the students spending holiday recess on Campus was a jolly affair. The center feature was a huge bonfire about which all gathered. Short talks were made. Dean Baker told a true story of a man who had the right kind of Christmas spirit—and told it as only Dean Baker can tell a story to young men. Mr. Adolfo, "Y" Secretary, gave a short address appropriate to the occasion. Professor Roa read with the charm of the true reader the ever beautiful story of the "First Christmas Eve" as St. Luke tells it. Mrs. Adolfo sang "Holy Night". Songs were sung by all and guitar music added to the pleasure. When the coals of the bonfire were just right, corn was popped, to many a new feature in Christmas festivities. Other refreshments appropriate for the season were served and all went home with an added touch of the beautiful Christmas spirit.

On February 1, 1926, Mr. José Gomez, B. Agr. '24, passed away at his home in Angeles, Pampanga. Mr. Gomez has been engaged in farming, and in the very short time allowed him gave promise of becoming a successful agriculturist.

New books and other publications added to the library of the College of Agriculture, December 31st, 1925.

Chemical Society

Annual reports on the progress of chemistry for 1922.

Deerr, N.

Cane sugar, revised edition. 1921.

Melbourne. Commonwealth Bureau of Census and Statistics. Official year book. 1925.
Punjab. Department of Agriculture.

Report on the operations of the department of agriculture. Part 2, Vols. 1 and 2, 1924.
Taylor, H. C., et al.:

Practical farm economics. 1924.

Readers' guide to periodical literature.

V. 13, 1913; V. 15 to 25, 1915-25.

In addition to the above, about 600 newly bound volumes were added to the accessions of the Library during the earlier part of December. These consist mostly of journals, magazines, periodicals and United States Federal and State documents. About 50 per cent of these publications were added in exchange with the PHILIPPINE AGRICULTURIST.

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